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THE

INDIAN FORESTER.

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NOTES ON THE UTILIZATION OF FORESTS.

(*Continued from page 42*).

Article 7. Wood used in Carriage and Wagon-making.

Wood used for this purpose should be as light as possible consistent with the requisite strength, hardness and elasticity. The only portion which forms an exception to the rule is the framework of high carriages, which must be heavy in order to keep the centre of gravity low.

The most important part of a carriage or wagon are the wheels. An ordinary wheel consists of a nave (or hub or hob), and of spokes and felloes.

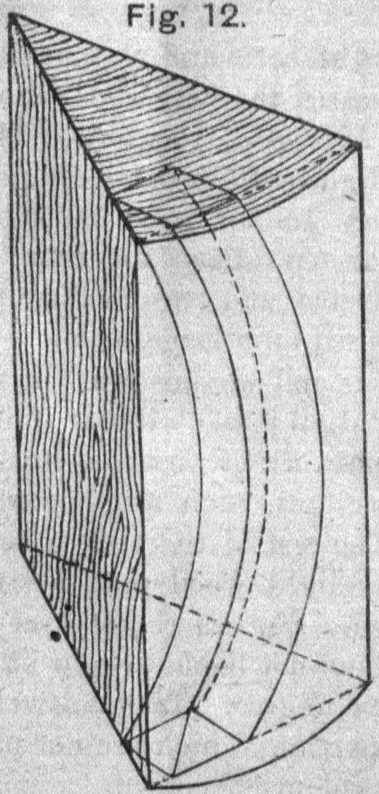
The nave must be able to resist great and violent shearing strains, and the wood must be so dense and hard that these should be unable to enlarge the mortises or holes in which the spokes are fixed and thus render the latter loose. It should contain no sapwood.

The best woods for naves are babul, sissu. sál, black-wood, teak, various Albizzias, and satin-wood.

The wood of spokes should be all heart-wood, very strong and hard, elastic yet rigid enough, not liable to warp or split, perfectly straight-grained, and without knots and any trace of unsoundness. It should be remembered that the whole weight of the carriage or wagon is borne successively by an individual spoke in each wheel, so that a single bad spoke spoils an otherwise perfect wheel. To prevent the tires from becoming loose in hot, dry weather, the length of the spokes should not be liable to vary much with alternations of atmospheric humidity. The most suitable woods for spokes are sissu, sundri, teak and babúl.

The felloes should be made of some wood that is able to resist crushing, is hard, elastic and strong, does not warp or split and is not liable to excessive expansion or contraction with varying quantities of imbibed water. Durability is also an essential quality, and hence no sapwood should be allowed to remain. To preserve all the strength and elasticity of the wood, the fibres should be cut across as little as possible, and hence the advisability of using naturally curved timber. When such pieces are not obtainable, then the felloes should be hewn out of split sections, as represented in *Fig.* 12, so that the concentric rings may all lie

Fig. 12.



Mode of cutting out fellies.

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as much as possible in the same plane as the wheel. The best woods for felloes are teak, babul, sissu, sál, nim and oaks. In many parts of India, where the ground is flat and the soil sandy, no tires are put on the wheels, and in that case hard, tough woods, like babul and sissu, answer best. In some parts of Europe "bent rims" are used as felloes for the wheels of light carriages, and occasionally the entire circumference of a wheel is formed of a single bent piece.

In teak-growing countries solid wheels for wagons are made, consisting of three pieces joined laterally, and held together by the

tire and by a pair of iron disks, one on either face, strongly rivetted together. The axle passes through the middle of the centre piece. Such wheels are extremely strong and durable.

In almost every part of India the axles of numerous carts are entirely of wood. To resist the enormous transverse strains due to the weight of the body and load and the heavy jolts on a rough country road, and constant severe friction, the wood should be very strong, hard, tough and elastic. The best axles are furnished by *Anogeissus latifolia*, sál, sundri, babul and *Olea ferruginea*. When the ends, on which the wheels revolve, are of iron, almost any strong hard wood will answer for the intermediate portion of the axle.

The poles and shafts of carts and wagons drawn by oxen should be very strong and elastic, the best woods to use are *Ougeinia dalbergioides*, *Diospyros Melanoxylon* and sál. The poles and shafts of carriages have to be light, and therefore thin and extremely strong and elastic. The best Indian wood for the purpose is sundri; but *Diospyros Melanoxylon*, *Anogeissus latifolia*, various species of *Grewia*, and well-selected and seasoned bamboo, are also found to be excellent and are used on a large scale.

The framing of carts and wagons must be made of very strong wood that holds well at all joints without splitting or breaking off. The wood in the frame-work of carriages must also be strong, and for some kinds of carriages, such as phaetons, it should also be naturally curved. The rest of the body of every kind of vehicle may be made of any light wood that is strong enough for the part where it is used. For carriages every bit of it should be thoroughly seasoned and not liable to split or warp, or to shrink or expand in an excessive degree. Teak answers excellently all requirements. Those portions which are not painted must possess a handsome grain and colour.

What has been said with regard to carts and wagons apply, with obvious modifications, to wheel-barrows, hand carts, &c.

As regards railway carriages and wagons, the wheels, axles and framing of the floor are of steel or iron. The sides and roofs are usually of wood of the very best quality—usually teak.

Gun carriages are subject to much more severe strains than any other class of vehicles. Hence great care must be exercised in choosing wood for them. Those portions on which the guns rest must also be very hard and tough, so as to resist friction well.

Sledges must be as light as possible. Hence only the strongest woods should be used. The runners are subject to enormous

friction ; they are therefore armed with removable soles, about $\frac{3}{4}$ inch thick, of some extremely hard wood. In the Western Himalayas *Quercus dilatata* furnishes the best soles.

Article 8. Coopers' Wood.

The cooper makes casks, barrels, tubs, pails and buckets for holding both liquids and dry goods. For holding liquids the wood should not be so porous as to allow any appreciable quantity of the contents to filter through. Moreover, it should not communicate any unpleasant or undesirable taste or odour to the contained liquid, nor impart any objectionable colour. Certain dry goods must also be similarly protected. Portable casks that are to contain liquids must be made of very strong wood, because of their great weight when full, and in order to withstand the constant violent shocks to which every portion is exposed whenever there is a jolt or shake ; and it must be remembered that the slightest crack or flaw will cause the liquid to run out.

The large quantities of rum and other spirits distilled in India and the rapid growth of the brewing industry in every part of the country, will soon require a large supply of staves for casks and barrels. The staves should always be split, but English brewers seem to be indifferent to whether those they use are sawn or split. For a hogshead are required

20 staves 3′ 3″ × 6″ or 5″ × $1\frac{1}{4}$″ and
10 head-pieces 2′ × 8″ or 6″ × $1\frac{1}{2}$″.

The head-pieces are the staves that go to form the top and bottom of the cask. Before they can be put together the staves have to be properly shaped and shaven, those forming the sides of the cask being kept thickest and broadest in the middle. When thus prepared, these latter are 3′ 1″ × 5″ (in the middle) × $1\frac{1}{8}$″. The head-pieces are reduced to a thickness of $1\frac{1}{4}$ inches.

Owing to want of enterprise the doubtless numerous kinds of Indian woods suited for cooperage work have hitherto remained unutilized. We cannot therefore do better than adapt from Boppe's *Technologie Forestière* his excellent description of the manner in which cask staves are made in France.

The staves are made principally in the forest, since wood is split most easily when it is fresh felled ; also because it is not every piece of timber that is adapted for the purpose, and in the forest itself the workmen can best choose only what is really suitable, and can often utilize the tops and butt ends which the sawyer rejects.

Three tools are used—an axe with a broad flat head like the

back of a wedge, the divider and the shave. The last two tools are clearly represented in *Figs.* 13 and 14 below.

Fig. 13.

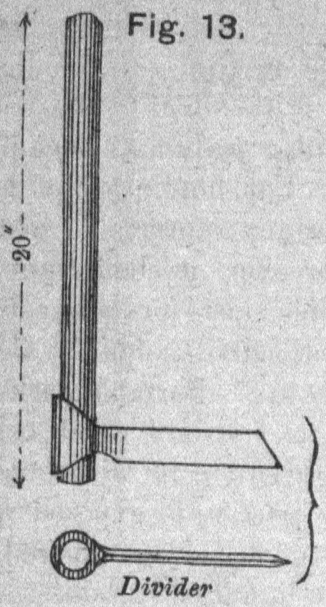
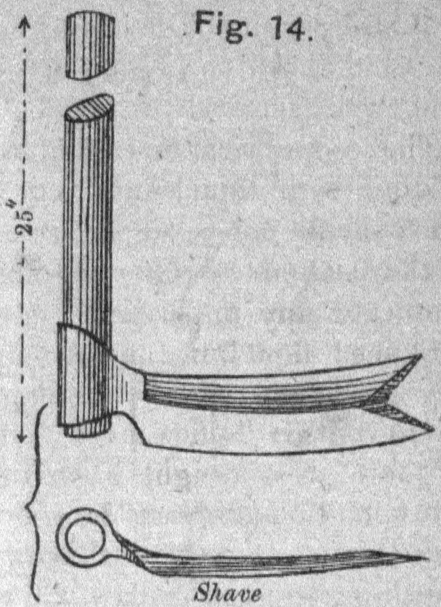


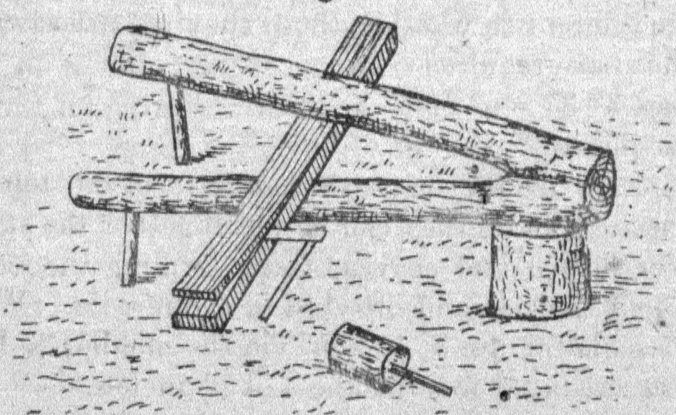
Fig. 14.



Stave-maker's tools. (After Boppe).

The stave maker's bench (*Fig.* 15) consists of the fork of a tree

Fig. 15.



Stave-maker's bench with divider and mallet. (After Boppe).

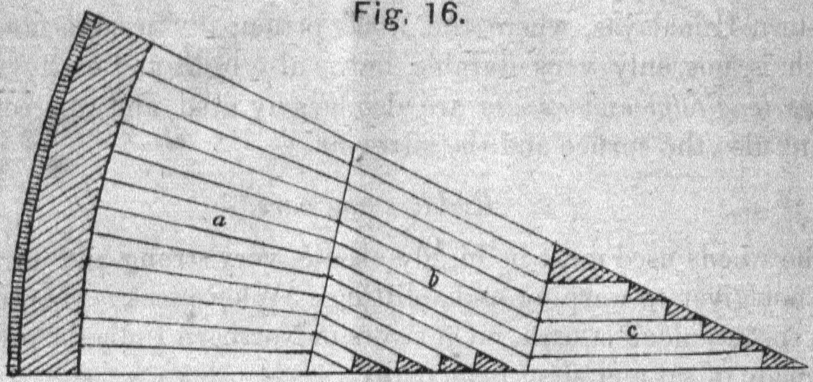
fixed on three stakes firmly driven into the ground.

The mode of working is briefly as follows :—Billets or rounds of the required length being sawn off the logs, they are split with the axe into quarters, and each quarter, if large enough, into sectors (*Fig.* 16).

The divider with a wooden mallet now comes into requisition. The sapwood and pith portion of each sector is removed, and the sector is split tangentially into pieces of the width of the staves

to be made. These pieces are fixed on the bench as represented in *Fig.* 15 and finally split up into staves. The divider being driven into the wood, the slit is extended by pressing on the handle and pushing the blade in further as the wood splits more and more. To facilitate this process it may be necessary to use the mallet now and then. The staves may be taken off by splitting the sections radially or along the lines of the medullary rays as at (*a*) in *Fig.* 16, or along parallel lines as at (*b*) and (*c*). The faces of the staves

Fig. 16.



Method of splitting wood for cask staves.
(After Boppe).

obtained by the former method are made parallel with the shave; this method is hence a more wasteful one than the other.

On the continent of Europe manual labour is sometimes replaced by special machinery, which turns out staves of much truer shape and size. But the action of such machines is partly a splitting, partly a cutting one.

In England the staves are cut with circular saws, and, after being shaved on one, the future inner, side, are steamed and pressed to the required curvature. This practice obtains also at Bordeaux, being not only much easier than splitting, but affording the advantage of utilizing seasoned wood.

Wooden hoops are now seldom used. They are furnished by poles and saplings, young stool-shoots being the best. If poles are utilized, they are first trimmed straight and clean, and then split. The hoops are made by forming them on blocks of the required girths while the wood is still green. If it has been allowed to dry, it must be steamed or soaked in water. Hoops for pails are always of rectangular section (about $2'' \times 1\frac{1}{2}''$), and are split from pieces of large diameter.

From what precedes it is evident that the wood used for cooperage purposes must have straight and parallel fibres, and be quite free from knots and other flaws and from every kind of unsoundness.

Article 9. Split wood for other purposes.

Split wood is used for shingles for roofs and walls, for rudders and oars, for trenails and pegs, for drums and sieve-frames, for veneers and thin boards, for matches and match-boxes, for musical instruments and for lead pencils.

1. *Shingles.*

Wooden shingles can be used only in cold dry climates where snow lies in winter. Actually their employment is confined to the Western Himalayas, where the wood principally used is deodar, which is not only very durable, but is also light and easily split. *Pinus longifolia* and *excelsa* are also largely used, and to a certain extent also the spruce and the silver fir.

2. *Rudders and oars.*

The woods used must be highly elastic, very strong and durable, and not given to warping and splitting. Where teak is obtainable, that species alone is used. On rivers in Northern India the paddles are made of sál and sissu principally.

3. *Trenails and pegs.*

Trenails are made of teak, since they must, if possible, be more durable even than the ribs and sides of the ship. They are from 16 to 28 inches long and 2 to 2½ inches thick.

Shoe and boot-makers and furniture-makers consume a very large quantity of wooden pegs. Any wood will do for pegs, which is tough and strong; it need not be hard, and yet it must not be so soft as to get flattened out when being driven in. An easy way to test wooden pegs is to bite the end between the teeth; unsuitable wood is easily bitten out of shape. Information regarding the species used is required. Bamboo pegs are very largely used by carpenters.

In this place may also be mentioned skewers for trussing up meat. Bamboo of any kind seems to be the most suitable wood for the purpose.

4. *Drums, sieve-frames and band-boxes.*

The Indian double-headed drum is made out of a whole piece of wood hollowed out; but the single-headed drum is, like the frames of sieves, made of a single band of split wood. One of the best woods for drums is the *Pterocarpus Marsupium*, which is remarkably sonorous; but any straight, even and sufficiently close-grained wood will be suitable. For sieve-frames the choice is less restricted,

and a soft wood, provided it is tough enough, will answer. The bottoms of coarse sieves are often made of woven strips of bamboo.

Band-boxes can be made only of woods that split well and can be easily bent into shape. The wood may be split into sheets as thin as the wood in match-boxes, or into boards nearly half an inch thick. The best woods for the purpose are conifers, on account of their long fibre and simple uniform structure.

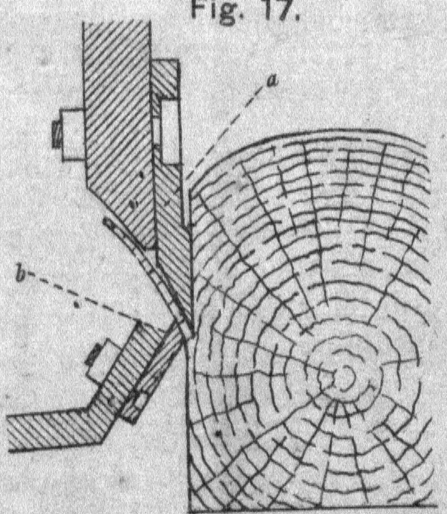
Under this head we may include the wood used in the sheaths of swords, knives and daggers. Simal is largely used for the purpose when coniferous wood is not obtainable.

The boards and thin sheets required for the purposes treated under this head, are most easily split with special machines, a most effective pattern of which will be found briefly described under the next head.

5. *Veneers and thin sheets of wood for various purposes.*

For veneers only ornamental woods that are also close-grained, tough and elastic can be used. They are often sawn with thin band saws, but they are best obtained by a process analogous to splitting. The Plessis machine is one of the most convenient and effective for this purpose (*see Fig.* 17). It consists essentially of

Fig. 17.



Plessis machine for cutting out thin sheets of wood. (After Boppe).
(a). Planing iron. (b). Heel to prevent sheet of wood from breaking or splitting off irregularly.

a heavy planing iron (*a*) working vertically on two guides, which can be shifted about horizontally, so that the edge of the blade may be moved along any given curve. The heel (*b*) moves *pari passu* with the plane, and, as it presses up against the sheet of wood being cut out, prevents the latter from breaking or tearing. The

wood to be treated is first cut up into billets of the required length. These billets, before being placed on the machine, are roughly squared and thoroughly softened by steaming. As soon as a billet has been cut up, the sheets are all put into drying presses heated with steam. They remain in these presses for a variable time, the average being about one minute for every one-twentieth inch of thickness.

6. *Wood for matches and match-boxes.*

For matches we require wood that is easily split and burns readily with a flame. It should, therefore, be soft. Conifers answer best. Match-sticks, or splints as they are called, are made from solid blocks cut to twice the length of a match, and having a square section of about 3 inches side. The blocks are first steamed and then placed in a special machine which knocks off several splints at a blow. The splints are dipped at both ends into the ignitible composition and cut across in the middle when dry.

The boxes are made of any soft wood that splits easily. All knotty portions are removed, and the wood is divided into small parallelopipeds of square section, which are then split by a special machine. Before the thin boards are pasted into the form of the box or cover, they are smoothed inside a revolving hollow roller.

7. *Wood used for certain musical instruments.*

These instruments comprise those of the violin class, guitars, mandolines, zithers, and sitars. For them the fibres of the wood should be cut through as little as possible in order to preserve their sonority. The wood should be completely free from every kind of flaw, and the grain should be straight, parallel and uniform, so as to secure even vibrations throughout and to prevent warping. The wood should also be thoroughly seasoned, and as little as possible liable to change of volume with alternations of moisture and drought. The bellies or sounding boards of the instruments are best made of conifer wood, while the sides may be made of some harder broad-leaved species. It is superfluous to say that sitars are the only instruments of this class made in this country.

7. *Wood for lead-pencils.*

The manufacture of lead-pencils is an entirely new industry in India, there being only a single factory at Poona. Wood for lead pencils must be even-grained, without knots and, while tough, nevertheless easy to cut with a knife.

Article 10. Wood for various articles wrought with adze and chisel.

Such articles are the backs of brushes, saddle-trees, shoe-makers' lasts, bowls and platters, spoons, moulds, rakes, clogs, toys, idols, gun-stocks, &c. For all of them only wood that does not crack or split or warp must be used. For the majority of them the wood should also be hard and tough. Wood used in any kind of saddlery must, in addition, be elastic.

Article 11. Wood for turning and moulding.

For both these purposes even-grained wood that takes a good polish is sought after. In most cases handsome colouring and marking are desiderata. Ebony is perhaps the best wood we possess, but we have a host of other extremely valuable woods—satin wood, blackwood, sissu, tun, teak, padouk, zebra wood (*Pistachia*), *Pterocarpus* spp., box, sandal wood, &c.

Article 12. Wood for engraving and carving.

For wood engraving we require wood that possesses a perfectly uniform texture, is close-grained (so as not to absorb inks and colours too freely), and is so hard and tough that the sharpest edges that can be cut withstands the heavy pressure to which it is subjected in the press. Box is pre-eminently the engraver's wood, but for rough wood-cuts any sufficiently even grained and compact wood will answer.

For carving and ornamental relief work similar wood is required, although the texture need not be so uniform and close or the grain so hard and tough. For open carving the wood should possess considerable transverse strength. Teak, on account of its durability and colouring, is greatly prized for all kinds of carved work. Sandal wood and ebony are used for fine ornamentation. Other good woods are sissu, blackwood, walnut, satin wood, *Adina cordifolia*, *Stephegyne parvifolia*, *Holarrhena antidysenterica*, *Wrightia* spp., maples, and a great many other species.

Article 13. Wood for packing cases.

The characters common to all woods used for packing cases are that they should be easily worked, light, yet strong enough for the purpose to be served, soft enough to allow nails to be driven in without splitting, and not liable to stain or taint or otherwise injure the contents. Deodar, although an excellent wood in every other respect, is generally too oily and strong-scented for any purpose.

One of the chief Indian industries requiring packing cases is tea manufacture. There are several sizes of cases to contain definite weights of tea, but in all the boards are only ½-inch thick.

According to Mr. Gamble the common tea-box woods in the neighbourhood of Darjeeling are tun, *Duabanga sonneratioides*, simal, *Canarium bengalense*, *Anthocephalus Cadamba*, *Acrocarpus fraxinifolius*, *Tetrameles nudiflora*, *Acer Campbellii* or *lævigatum*, *Engelhardtia spicata*, *Echinocarpus dasycarpus*, *Nyssa sessiliflora*, *Machilus edulis*, and *Beilschmiedia Roxburghiana*.

In the Dehra Dún mango is the only wood in which the planters pack their tea, although there can be no doubt that numerous other woods will be found to be equally suitable. In Chhota Nagpur even such an inferior wood as *Boswellia serrata* is employed.

Information under this head is required from the tea districts of Assam and Cachar, Kumaon and Kangra. Besides the qualities essential to all kinds of wood used for packing cases, wood for tea boxes must also possess the necessary one of not corroding the lead lining. Green wood of most kinds has this injurious effect, notably *Erythrina* and the wild mango, and, according to Dehra Dún tea planters, also *Pinus longifolia*. Teak is used in some places, but it is far too valuable a wood to be wasted on tea boxes.

Opium manufacture also requires a very large quantity of wood, *Boswellia serrata* being chiefly employed. The wood of this species is not at all strong, but as it seasons very slowly, it is probably useful in keeping the opium moist.

Article 14. Wood for agricultural and garden purposes.

Under this head we have ploughs, harrows, hoes, clod-crushers, rollers, poles and laths for training climbing plants, thorn fences, rakes, hay forks, tool handles, &c.

The plough is made of any hard and strong wood that consists of the stem and a large branch making the required angle with it. In teak-producing districts that species is almost the only wood used on account of its great durability, and the ease with which it is worked. In the Himalayas various species of oak are utilized. Sál, sissu and babul also make excellent ploughs. The shaft is made of any strong, elastic wood, the best being *Ougeinia dalbergioides*, *Diospyros Melanoxylon*, sál and species of *Anogeissus*. The yoke is made of the same wood as in the case of carts.

Bullock hoes, being confined to the teak-producing provinces, are made of teak, the shaft and yoke being of the same woods as in the plough.

In harrows and rakes the teeth must be made of some strong

tough wood that wears well under constant heavy friction. Sissu and babul are the species mostly used.

For clod-crushers and rollers any hard and heavy wood will answer, the heavier the better, such as *Hardwickia binata*, sál, *Mesua ferrea*, babul, &c.

Small wood is so cheap and easily obtainable in most parts of India, that for poles and other supports for climbing plants any wood that will last through one season is considered good enough, except in the case of well-kept gardens and orchards, when only the most durable woods, such as teak, sál, &c., are used.

Forks for hay-making and for lifting up branches (especially thorny ones) for hedging purposes, consist of a single stem terminated by two equal branches starting from the same point. The wood should be light and at the same time very strong and tough. The same qualities are required in wood for the handles of picks, hoes, spades, shovels, axes, &c. Solid bamboos are excellent for axes, hoes and picks, the thicker end being cut just below a knot that cannot slip through the eye. Species of *Zizyphus* and *Grewia* also make very good tool handles. In the Western Himalayas axe handles made of *Cotoneaster bacillaris* often last three years.

Article 15. Timber for various miscellaneous purposes.

There is a very large demand for lance staves in every military country of the world. Straight, solid, gently tapering bamboos are unrivalled for this purpose, but they are extremely difficult to procure at present, and the German army is now adopting hollow iron instead of wooden staves.

Wooden combs are in universal use among natives, the woods used being box, ebony, *Stephegyne parvifolia*, *Adina cordifolia*, sissu, bamboos, several *Gardenias*, and several other species with straight and uniform grain.

Wooden hat pegs are to be found in almost every house furnished according to European ideas. Any wood capable of being turned and of taking a good polish is suitable for the purpose.

Handles for chisels absorb a fairly large quantity of small timber. *Terminalia tomentosa*, khair, sissu and teak are very generally used, the first two being the best.

Anvil blocks and blocks on which butchers cut their meat require a hard tenacious wood, sál and babul being excellent for the purpose.

The manufacture of walking-sticks consumes a considerable quan-

tity of branch wood and saplings. Amongst monocotyledons we have canes, bamboos and palms ; amongs tdicotyledons we have oaks, cotoneaster, ebony, *Mimusops indica*, *Alangium Lamarckii*, *Prinsepia utilis*, &c., &c.

Article 16. Wood for basket and mat-making.

Bamboos and canes are *par excellence* the materials for making baskets and mats. The bamboos should be cut for the purpose before they are a year old, as they afterwards become too highly lignified to split well or to bend and take new shapes easily. Dicotyledons largely employed for basket-making are willows, *Vitex Negundo*, *Nyctanthes Arbor-tristis*, *Homonoya riparia* and numerous other shrubs forming a profusion of long, twiggy, highly flexible shoots. In every case the wood should be used in a green condition ; the fresher cut, the better. Wood for basket-making, although flexible while green, should become fairly rigid when dry, in order that the articles made from it may keep their shape. For this reason climbers are seldom suitable for the purpose. In the case of dicotyledonous species stool and pollard shoots furnish the best material.

Article 17. Wood used for the manufacture of packing material.

Thin shavings of wood are now coming largely into use for the packing of brittle articles. This wood wool, as it is called, is very rapidly prepared by special machinery, which will work up pieces as small as ½-inch in thickness and 6 inches long. The softest woods, possessing long, straight and parallel fibres, will furnish the best material.

Article 18. Textile wood-fibre.

Wood wool, as described in the preceding Article, is digested in a solution of sulphuric acid in hermetically sealed, slowly rotating boilers, the encrusting matters being thus separated from the cellulose, which becomes white and lustrous like silk. These thin strips of fibre are then dried in special ovens, in which they acquire great toughness and elasticity. They are now moistened and passed between grooved rollers, which, in flattening them out, displace the fibres to such an extent that a little twisting suffices to separate these last from one another. In this condition the fibres may be spun and woven like cotton or flax.

Article 19. Wood pulp.

Paper consists of cellulose with some sizing substance added in order to prevent ink from running. Hence, if we remove from wood everything but its cellulose, we get paper-making material, or, as it is called, paper stock. Paper made entirely of wood stock is, with the sole exception of that manufactured from young half lignified bamboos, rather brittle and coarse-grained; but, on the other hand, it takes a cleaner impression and wears away the type less than printing paper made from linen or cotton rags. Moreover, wood pulp is very much cheaper than stock prepared from rags. Mr. Routledge, the great paper manufacturer, made samples of paper from bamboo stock, which were equal to the finest qualities of linen and esparto paper.

Wood pulp is not only used by the paper manufacturer, but serves for a variety of other purposes. By penetrating it with special glutinous substances and subjecting it to high pressures, it can be made as hard and as durable as one pleases, and be moulded to any shape. Picture-frames, toys, ornaments, &c., are thus made; also slabs, which may be substituted for boards and planks, and are practically unbreakable, and cannot warp or split even in the most trying surroundings. In America solid railway-wagon wheels are made of a skeleton of steel with specially prepared wood pulp forced in between under great pressure. Such wheels last very much longer than purely iron or steel wheels, and, being of much more elastic material, produce very little jar, and minimise wear and tear of the rolling stock and permanent way. The loose fibre is used for stuffing cushions, as packing material and for filtering water.

The pulp may be made either (I.), by physical means, by rending asunder the fibres between grind-stones, or (II.), by separating the fibres chemically by maceration.

I. The Physical process.—The wood should be fresh-cut. It is first barked, divided into short sections, about a foot long, and split up, all knots and decayed portions being removed. The small pieces are then broken and ground up in the mill, through which a constant stream of water is kept flowing. The water carries off the broken fibre and dissolves away all clogging substances. The coarser portions carried down by the water are separated by a special contrivance, and ground down again to the necessary fineness. When the reduction is complete, the superfluous water is removed, and the pulp is sorted out into different qualities according to its fineness. In Germany alone over 6,000,000 cubic

feet of wood is made into pulp by this method. The pulp thus obtained is used principally as paper stock.

II. THE CHEMICAL PROCESS.—The wood is divided into billets and barked. The billets are then sliced obliquely by a special cutting machine into pieces about ½-inch thick. These pieces are passed between fluted rollers, which break them up into chips about ½-inch long and from ⅙ to ¼-inch thick. The chips are next put into pierced iron barrels placed inside a large boiler. The boiler is then hermetically closed and completely filled with a strong lye of caustic soda, and fires are lighted below. After from three to four hours, during which the pressure of the steam inside reaches a maximum of about 10 atmospheres, the process of digestion is complete, the fires are put out, and the boiler is emptied and opened. The contents of the barrels, which is now pure cellulose (the maceration having dissolved away all the coating and cementing substances), are thoroughly washed with plenty of water, refined and bleached, and passed between several sets of rollers, from the last of which the entire mass issues forth in appearance resembling a large sheet of felt. The sheets, while still moist, are sprinkled over with sand and rolled up and formed into bales.

From the lye after it leaves the boiler, and from the first washings, from 75 to 80 per cent. of the soda is recovered and can be used over again. The substance obtained by this process is the pure cellulose of the wood in an unbroken condition, and is, therefore, not only adapted for paper stock, but also for the manufacture of pressed articles, for stuffing cushions, for packing, for filtering, &c. The yield of cellulose by this process is roughly 25 per cent. of the air-dried weight of the wood.

MR. ROUTLEDGE'S METHOD OF PREPARING BAMBOO FIBRE FOR PAPER STOCK.—According to this gentleman the young bamboo culms, while they are still semi-herbaceous, should be passed between two rollers resembling the rollers of an ordinary iron sugar-cane mill. This crushing presses out all the sap and glutinous substances, and reduces the culms to the condition of long flexible ribbons, which, after being dried, can be made up into easily exportable bales. The cleaning and bleaching processes can be effected at the regular paper mills as in the case of rags and raw fibres.

WOOD SUITABLE FOR PAPER STOCK.—Dark-coloured woods are always unsuitable, since their bleaching would be unnecessarily laborious and costly. Heartwood is also inappropriate, firstly, on account of the dark colour, and secondly, on account of the encrusting matters that cause the sapwood to become heartwood. It is

evident that the wood should also not be too hard. Poplars, willows, the firs, most of the pines, species of *Sterculia*, *Boswellia*, and other soft and rapidly growing species will doubtless prove excellent for the purpose. The best wood is furnished by stems not exceeding 1 foot in diameter.

Section II.—Firewood.

In spite of the innumerable different requirements of the population in respect of timber, the demand for firewood is many times larger, and will not only remain so, but will even increase in greater proportion with advancing civilisation and wealth and higher prevailing standards of comfort. Considering fuel for cooking purposes alone, the annual consumption, at the very moderate daily rate of 1 lb. per head per day, must already exceed 300 millions of solid cubic feet. Insufficiency and badness of communications keeps down the demand as well as the supply brought into the market, and millions of cubic feet rot or stand unprofitably in the forest owing to impossibility or prohibitive cost of export.

Firewood may be used for two sets of purposes, *viz.*, (1) directly for the heat and light it gives out in burning, and (2) indirectly for certain products which form when it is burnt.

(1). *Wood burnt for heating and lighting purposes.*

Wood may be burnt until it is consumed, or it may be burnt only to a limited extent and converted into charcoal for future use.* Wood charcoal gives out the highest calorific effect of wood, and is hence alone used for smithy and foundry work and for other purposes which require not only a steady and prolonged, but also a very intense, heat. For glass-making and ore-smelting also charcoal should exclusively be used, but owing to the primitive condition of the arts in India, the hardest and heaviest woods are sometimes employed. For the production of steam (as for driving machinery, soap-making, laundry work, &c.), charcoal is the best, but with a strong draught the harder woods yield completely satisfactory results (the softer woods are not used at all, because they burn too quickly, and hence do not maintain a sufficiently steady heat). For the kitchen also charcoal holds the first place, both on account of the even heat it gives out and for its burning without smoke. Hence the exclusive use of charcoal for roasting, baking and grilling ; but when wood can be used, the choice between the soft

* The manufacture of charcoal will be described in detail in Part III.

and light and the hard and heavy kinds depends on the nature of the food to be cooked according as it requires a quick or a slow fire. The baker, the potter, the tile and brick-maker, the lime-burner, the stoneware manufacturer, &c., require a fuel that burns readily and gives up all its heat quickly, and hence prefer the softer and lighter woods. For warming purposes the best adapted are the heavy woods, that are not reduced to ashes at once, but form large masses of glowing charcoal, and which do not crackle and splutter or emit clouds of black pungent or malodorous smoke.

In the Himalayas the resin-gorged wood of pine and deodar stumps is split up into chips and splinters, and burnt in a chafing dish in place of a lamp, giving out both light and heat. Dry bamboos, bruised so as to become full of numerous long cracks, burn like torches, and are so used by night travellers through the jungles. The green branches of the torch tree (*Ixora parviflora*) are also used for torches.

(2). *Wood burnt for the products of combustion.*

When wood is burnt (dry distilled) numerous substances are given off in the smoke and vapours, such as lighting gas, acetic acid, wood spirits, ether, creosote, tar, pitch, soot, &c., the quantity of these substances increasing with the temperature to which the wood is raised, *i.e.*, with the rapidity of the distillation. In the ashes, we have potash and various other salts. The woods that constitute the best fuel also yield the largest quantity of acid, small branch wood being the richest. Tar and pitch can be obtained in remunerative quantities only from resinous conifers. The destructive distillation of wood is usually effected in large iron vessels connected with a condenser. Tar and pitch may be easily made by heaping up the wood to be burnt in a pit, at the bottom of which there is a receptacle or a hole in communication with a receptacle. After being filled, the pit should be very nearly closed with sods, only a small opening in the middle being left in order to admit a sufficient supply to maintain the wood at a glowing heat. The wood should be split up small. As the wood burns the tar and pitch run down to the bottom and is thus collected.

(*To be continued*).

ON THE TREATMENT OF BAMBOO FORESTS.

From 15 to 20 per cent. of the total revenue of the Central Circle, N.-W. Provinces, is derived from the sale of bamboos. The question, therefore, of the rational treatment of bamboo forests is of

importance. There are apparently no works to which reference can be made on the subject, and personal experience is acquired slowly. It is in the hope that the method of treatment adopted in other Circles and the observations made by other Forest officers may be made public in the "Indian Forester" that the following notes are forwarded to you.

In this Circle the question of framing the most suitable rules for regulating the cutting of bamboos, which here consist entirely of *Dendrocalamus strictus*, has occupied the attention of Forest officers for some years. Numerous cases of overcutting were first noticed by Sir D. Brandis during his last inspection tour in 1881, and it is likely that at that time many more accessible portions of the Circle were overcut, whilst the less accessible were practically unworked. The result of this localization was evident in the poor quality of bamboo exported, a large percentage consisting of shoots of the year which shrivelled in drying and had a low market value. Again, the arrangement of the price list favoured the export of thin bamboos, so that exporters found it profitable to cut the upper portion of the stem, leaving stumps from 3 to 5 feet high standing in the clumps, and such clumps became in a few years inextricably entangled, so that it was almost impossible to extract full-sized bamboos.

The first attempt made to favour the production and growth of the bamboo was by altering the price list so as to make inferior and thin stems no more profitable to the exporter than good quality stems would be. This measure was indispensable, and gave the relief it was intended to. At the same time a general order was issued that four stems should be left standing in each clump, the idea being that it was necessary to stop the practice of cutting clumps down entirely, and that in all probability the four stems left would be the immature shoots of the year. This measure was insufficient; it proved extremely difficult to enforce, and it was found that if four stems were left, they were not necessarily the shoots of the year, and were indeed in most cases poor miserable shoots of no use to the exporter and of little to the parent root-system. One good, however, did accrue from this first attempt, and that was the establishment of a more perfect system of registration by means of passes issued by the Ranger ensuring the responsibility of cutters for damage done in the areas mentioned in their passes. The failure of the first protective measures was necessarily followed by more stringent rules founded on experience.

The second system consisted in (i), division of the forest into blocks to be closed for varying periods until the most suitable

rotation is discovered, (ii), prohibition of cutting stems of the year, (iii), prohibition of cutting any stem at more than 1 foot from the ground. Beyond this some forests which, from having been open to rights and easily accessible, had been woefully abused, were closed outright for a term of years to permit the exhausted bamboo stock to recoup. In these days when revenue is of importance, when the Forest officer is pledged to show that improvement of forests and increase of income go together, it required some hardihood to initiate such drastic remedies likely, by closing a large percentage of productive area, to reduce revenue at a corresponding rate. But fortunately, demand being brisk, these rules, issued at a risk, have had the effect of opening out the less frequented forests, and revenue has not fallen off, though the quality of material exported and the standing crop is greatly improved. The working plan for bamboos at present in force in this Circle comprises therefore (i), a system of passes, each cutter being personally responsible for the tract mentioned in his pass ; (ii), the arrangement of the price list so that no advantage is gained by exporting inferior produce; (iii), the closure of certain blocks annually ; (iv), charging a higher rate for bamboos extracted from blocks closed to cutting during the previous year ; .(v), prohibition of cutting stems of the year, and (vi), prohibition of cutting any stem higher than 1 foot from the ground.

Clauses (i), (ii) and (v) call for no remark, and the advantage of the prohibition under clause (vi) is self-evident—at any rate there is no apparent advantage in leaving 3 to 5 feet of good bamboo to wither gradually, its presence cannot protect the young shoots for more than a few hours, whilst by cutting close to the ground the clump remains open and clear, there is no chance of entanglement preventing easy extraction in future years, and there is direct gain in utilising the entire stem which frequently provides two sticks where one only was formerly exported. With regard to clause (iv), experience will show what is the best method of collecting the exhanced price. Auction sales are doubtless the most productive, but are impossible when the forests are worked by men of small means and without capital. Moreover, the sale of a monopoly in any block might tend to favour overcutting, that is, the exporter must add the price of his monopoly to the cost of extraction and carriage, and the more material he exports the cheaper he would afford to sell. On the other hand, there is difficulty in collecting an enhanced rate from several exporters, while the sale of similar produce at various rates is confusing, occupies much of the Ranger's time, and gives an opening for trickery.

The important point is, however, to discover whether the welfare of the bamboo and its revenue-producing powers are best served by (*a*), opening blocks for two years and closing for one year; or (*b*), opening and closing in alternate years; or (*c*), opening for one year and closing for two. We wish to ensure to a clump the full term of its natural life, and during this period to remove as many marketable stems from it as possible without impairing its productive vigour.

In the first instance, 33 per cent. of the available area would be closed annually, but it would seem that there are some objections to this rotation—1*st*, of the area open to cutting one-half would have been under protection the previous season and the other half open to cutting, causing thereby a variation in rates; 2*nd*, given a steady demand that is likely to continue, opening 66 per cent. of the forest does not sufficiently restrict operations, and thereby drive exporters to the inaccessible localities; and 3*rd*, one year's protection after two years of heavy local cutting is probably not sufficient to maintain the bamboo in full vigour. If blocks are closed to cutting every third year, the only prohibition being under clause (v), *viz*, that stems of the year are not to be cut, and if at the same time it happens to be to the advantage of exporters to remove as many bamboos as possible, it is probable, or at least possible, that at the close of two working seasons such blocks would contain only stems which had sprung up during the previous autumn. The result of this treatment would probably be increased activity in the root-system, and the springing up of numerous shoots during the ensuing monsoon in the natural effort to provide sufficient foliage to support the life of the clump. This theory is borne out by observations made this season, when it was observed that fewer new stems were present in a forest closed to cutting than in one cut over in the preceding spring. It is, however, likely that a clump repeatedly culled in, that is twice every three years, to produce an abnormal number of new shoots, would be liable to become exhausted in the effort and ultimately die prematurely; and for this reason it appears that the second rotation above noted has a decided advantage.

In the case of closing and opening blocks in alternate years, the fact of the area being more restricted would lead to the extraction of all marketable stems if at all accessible. The heavy crop of new stems consequent on clear-cutting would then have time to harden and be ready for the next rotation, whilst uniformity of price would prevail in the Circle, and the general price list could then be altered to meet the needs of the changed circumstances.

Taking the third plan of two years' rest after one year's cutting, the advantage gained would be that a large proportion of the bamboo would be in its third year, and, therefore at its prime, whilst we could be perfectly certain that the clumps were not overworked. On the other hand, the closure of so large a proportion of the productive area and diminution of the new crop over that area (on the theory that cutting produces new stems) would doubtless be a serious hindrance to the income and unnecessary as a protective measure. It is assumed in the above remarks that all the marketable stems in a forest open to cutting would be removed. Although this would not invariably be the case, yet this is the basis we must work on ; for, in the first instance, it is permitted and favoured by our rules, and, in the second instance, if we intend to keep up the revenue from this source, to supply the local market and yet to close yearly from 30 to 50 per cent. of our productive area, we must expect to find that exporters will not leave much of value behind them.

The advantage of closing a bamboo forest for more than two years is not at present apparent, except in those special cases where prolonged ill-treatment necessitates prolonged protection. It is probable that in normal conditions the annual crop of new stems would be much diminished, and after the second year there is actually no improvement in the quality of the mature stems, but rather, in the opinion of merchants, a deterioration in value. But this and many other points can only be decided by actual experience, and it is a record of such experiences that we are so badly in want of. As a rule natives are wonderfully incapable of accurate observation, and their statements are not to be relied on without further enquiry. For instance, the orders regulating the height at which stems must be cut are unpopular, and it was generally asserted that the death of the clump would follow such treatment. Yet the solid variety of bamboo used for "lathis" is generally cut close to the root, and often below the surface of the soil, and it has not been noticed that this has any injurious effect.

The seeding of the male bamboo is a subject of which little is recorded. It may be theoretically correct to say that it flowers annually, but in practice it does not do so in this Circle. Solitary flowering clumps may indeed be found every season, and in these clumps sometimes one and sometimes many stems bear flowers. But as a rule the bamboo flowers at long intervals over large areas, though not over entire districts, and when this occurs the clumps in these areas dry up and the ground is covered with seedlings. It has often been observed that clumps which have been so maltreated by

men and cattle as to be at the point of death, carry flowering stems, and it almost seems that the circumstances which influence the seeding of bamboo are those which are conducive to the death of the clump, such as age, continued drought, or persistent maltreatment; this would also explain the providential coincidence of bamboo seed with famine years, as mentioned in Brandis' Flora.

It is a question for consideration whether fire-conservancy is beneficial in mature bamboo forests. It has been observed that continued successful protection so favours tree growth that after some years the bamboos die for want of light, and it is in these cases extremely interesting to note the struggle made by the new shoots to reach the light above the tree growth. But this struggle ultimately ends in failure. Pure bamboo forests, which, however, are infrequent, are self-protective after a few, say 12 or 15 years. It is in this first period that protection is necessary, but the absence of cattle is even more important than keeping out fire. Cattle graze during the winter months when the leaves are green, and probably often uproot the seedlings when grazing, whilst fires occur only after the seedling has died down, and, if not very severe, do not seem to injure the root. Those seedlings in the immediate neighbourhood of the parent clump, however, rarely escape destruction in forest not under fire protection, as the dry bamboo burns with an intensity fatal to most young growth in its vicinity.

S. E.-W.

THE FORESTS OF THE UNITED STATES.

I.—The Forest Regions.

The general division of the forest of the United States into two longitudinal belts, *viz.*, the Atlantic and Pacific belts, is a natural one, and has long been adopted by American scientists. Between these two belts, separated from them by a broad strip of prairie, may be placed a third, which may be called the North American forest belt, and which comprises the forests of the ranges east of the Bernardino Mountains.

Within each of these belts, depending on latitude and altitude, are distinguishable four regions differing in climate and vegetation. It is the establishment of these four regions which is the object of this paper; and as they do not quite fit in with the hitherto-published views of the American scientific world, it is hoped that this paper will also have the effect of eliciting an

interesting discussion, and perhaps of leading to a definite settlement of the question.

The present distribution of plants, especially of the forest trees, is the result of a slow struggle for existence between one another during many thousand years. There seems no reason for sudden changes, except from the action of man. Hence the actual geographical distribution of plants may be taken as constant for a long series of years to come.

The vegetation of the whole globe may be divided into several regions running parallel to the equator, and differing in climate as well as in flora, which indeed is partly the outcome of the former. Hence, where the climate is sufficiently well known, the lines of separation between the several regions may be traced out even independently of the floral features. This method is indicated where, owing to peculiarities of soil, typical representatives are replaced by other forms which ordinarily grow in different regions, such as pines in light sandy soils, or the swamp and white cedars in wet ones.

The boundary between two regions is actually defined by a belt, the width of which varies according to the gradual or rapid change of climate and flora from one to the other. But for scientific purposes such a boundary is assumed to be a mathematical line, that ought to coincide with a certain parallel of latitude, but never actually does so owing to such causes as the unequal distribution of land and water, the irregular configuration of the continents, warm and cold currents, differences in the prevailing winds, &c.

There exists a very striking parallelism between Eastern America and Eastern Asia, also between Western America on the one hand, and Western Asia and Europe on the other. The Gulf Stream, after running up along the south-eastern coast of the American continent to 36° N. L., turns off north-east, striking the western coasts of Europe, to which it gives their exceptionally mild climate. The Japanese current, the *Kuro Shiwo* (literally, the dark salt stream), glides along the south-east coast of Japan, and bending thence north-east at the same latitude (36° N.) as the Gulf Stream, finally strikes the western coast of North America in high latitudes, so that the climate of that region, in spite of its more northerly situation, is no colder than that of the European coast washed by the Gulf Stream. In both regions forests may extend as far north as the 70th parallel of North Latitude, while on the opposite or eastern coasts of the great continents which are washed by cold currents, forest growth ceases at about Latitude 50° N.

The preceding facts can scarcely be a matter of dispute, but they do not seem to have been sufficiently taken into account in the demarcation of the different floral regions, which demarcation should be based especially on the distribution of the forest trees, since they are far more typical and important than any kind of shrub and most of the herbaceous species. Owing to the cold and warm currents, the configuration of the continents, and the prevailing winds with their variable amounts of moisture, we may expect a very irregular course of the lines separating the different floral regions. And just as the isobars over a continent must be drawn closer together, the nearer the maxima and minima pressures are situated to one another and the greater their difference is, so the several belts, representing the different zones of vegetation, must be made narrower, the nearer the cold and warm water currents, with their influence on the climate through their extremes of temperature, approach each other.

Thus the whole distribution of the forest flora along the Atlantic coast lies between the northern limit of the tropical region (26° N.L. as I am inclined to fix it in Florida) and the limit of tree growth coinciding with the 50th parallel of North Latitude, and hence comprises a tract extending over only 24 degrees. By dividing the country north of the tropical region into three equal zones, each of these would include a belt not more than 8 degrees wide, while on the Pacific coast each of these three belts would extend across nearly 16 degrees.

(1) *The Tropical Region.*

If we adopt the tropics of Cancer and Capricorn as the northern and southern limits respectively of the tropical region, then the tropical flora does not enter the United States, or any island of the Japanese Empire. But it is a fact well acknowledged by all authors who have studied the North American flora, that it contains no less than 41 genera and 50 species of trees (taking 8 metres as the minimum height of a mature tree), which are entirely tropical, *i.e.*, attain their maximum development only within the tropics. Besides the area included within the tropics, those other localities, where tropical trees are found growing in a wild state *to the exclusion of trees of all other regions,* also belong to the tropical region, notwithstanding their geographical situation. Thus within the territory of the United States, we see tropical trees growing on the keys (*cayos*) off the coast of Florida, and on the coast itself from the southernmost point as far north as Tampa

Bay. This portion of the United States belongs, therefore, to the tropical region, its exceptional position right in the course of the warm Gulf Stream probably accounting for this fact. Consequently besides the subtropical, a tropical region is found in the United States, which forms the most northerly limit of the tropical West Indian and South American flora. Besides the flora, the climate of the places above-mentioned is really tropical also. Thus at Key West we have—

Mean temperature during May, June, July, August, ...	28° C.
Mean temperature during November, December, January, February, ...	22° „
Mean annual temperature, ...	25° „
Lowest temperature on record, ...	7° „
Amount of rain during four warm months, ...	437 mm.
„ „ „ year, ...	2,000 „
Mean relative humidity during four warm months, ...	71 per cent.
Mean relative humidity during year, ...	73 „

Comparing the climate of Key West with that of Rangoon in Burma (17° North Latitude and unquestionably situated in the tropics), we find at the latter place—

Mean temperature of the four months (May—August, inclusive), ...	26° C.
Mean temperature of four months (November—February, inclusive), ...	24° „
Mean temperature of year, ...	26° „
Lowest temperature on record, ...	14° „ in 1884.
Amount of rain during four warm months, ...	1,700 mm.
„ „ „ whole year, ...	2,500 „
Mean relative humidity during four warm months, ...	84 per cent.
„ „ „ „ whole year,	78 „

There exists hardly any difference between the climate of Key West and Rangoon as far as temperature is concerned; only the amount of rain is in excess at Rangoon. But this difference cannot militate against the statement that the climate of Key West as well as its flora are truly tropical, since there are many places well within the tropics, *e.g.*, Madras, (which is under the 13th parallel of latitude,) where during the four warm months only 312 mm. of rain fall, and during the whole year only 1,250 mm.

We may expect similar conditions of climate on the most southerly island of Japan, *e.g.*, the Rinkin group, which are exposed to similar climatic influences with the Keys of Florida. Unfortunately no meteorological data are at hand, and the nearest station where regular observations are registered is at Kagoshima in the southern island of the Kinshin group, six degrees further north than the southernmost island of the Rinkin group. But these suffice to prove that the station is entirely outside the tropics. The flora of Bonin and the southern Rinkin islands, which have hitherto been very incompletely explored, contain at least 15 genera and 20 species of tropical trees that attain their greatest development in Malacca and Java. It is from these islands of Bonin and Rinkin that Japan derives her supply of bananas and pine-apples.

The tropical region is enormously developed where the equator passes through broad stretches of continents, as in South America and in Africa, where every new traveller reveals fresh wonders of luxuriant tropical growth. The same thing occurs in Asia, the East and West Indies and the large islands between Asia and Australia.

(2). *The Subtropical Region.*

North and south of the tropics the extremes of climate are more marked, heat increases in summer and the cold in winter. The weather from May till August is very hot, accompanied by want of rain and low relative humidity of the atmosphere.

The cool moist winds from the sea, on their way over the continent, are soon heated and thus dried up, so that a few degrees from the coast the relative humidity of the atmosphere soon sinks below 50 per cent. At this point the limit of forest growth is reached. Mexico, the northern part of Africa, Southern Europe, Arabia, Persia, are all within the subtropical region. They support a poor subtropical flora within the vicinity of the sea, while the interior is mostly open shrub and grass jungle, or even desert of the most desolate description. Where, however, the hot winds strike up against high mountains or pass over high plateaux, they get cooled, their *relative* humidity being thereby increased and the formation of fog or rain being the consequence. Here a rich subtropical flora may be found up to an elevation where trees deciduous in winter begin to prevail. This occurs in the Atlas Mountains in Northern Africa, in the Himalayas, on the mountains of Northern Mexico, in Arizona, New Mexico and California. In Eastern Asia there prevails from May to December (the months of princi-

pal vegetative activity) a strong south-west monsoon, which, loaded with moisture, causes more rainfall and relative humidity of the atmosphere than during the rest of the year. To these favourable conditions must be ascribed the abundance of subtropical forms in China and Japan.

Within the limits of the tropics no frost ever occurs, but places in the subtropical region may not unfrequently experience slight degrees of frost. The subtropical region in the American Atlantic belt is reduced to a narrow strip of country and limited to a small number of species. On one side the great mass of deciduous trees partly favoured by the cold current and partly by the free exposure due to the wide stretch of continent, advances 5° further south to the 30th parallel of latitude (the 35th parallel being generally the northern limit of the region). On the other, the tropical region, owing to the warm sea currents, extends 4° further north than its average limit, *viz.*, to 27½° N.

Hence the subtropical region of the Atlantic forest belt comprises only the middle and northern parts of Florida and a small strip of land on the Atlantic coast washed by the Gulf Stream and extending up to the 36th degree of latitude. But even that small strip is little suited for evergreen broad-leaved trees, which require a rich soil for their growth. Most of the country referred to consists of a light sandy soil too poor for broad-leaved species. These, therefore, give way to pines, which everywhere take their place in similar localities. Other places are too wet for pines or broad-leaved trees, and either have no trees at all or support only forests of such conifers as *Taxodium* (the bald cypress) or of *Chamæcyparis* (the white cedar). The flora of the subtropical region within the Atlantic forest belt, so contracted as the region is, owing to the configuration of the country, proximity of cold currents and poorness of soil, is so poor, that it has been entirely overlooked. It comprises only 9 genera and eleven species of forest trees capable of attaining a height of three metres.

While on the Pacific coast the tropical region does not enter the United States at all, the subtropical region stretches along two-thirds of the length of coast of California as far north as the boundary between that State and Oregon, *i.e.*, up to the 40th parallel of latitude, or 5° beyond the average limit. But that broad strip of country supports only a small number of evergreen broad-leaved trees, partly because the country is intersected by vast belts of prairie, and partly because 5 genera, comprising 12 species of conifers, take their place. Thus the Angiospermous flora includes only 7 genera and 10 species of forest trees.

The subtropical region, on the other hand, of Eastern Asia is remarkably rich. A broad belt of evergreen forests along the Chinese coast and on the great southern islands of Japan belongs to this region, which, owing to the warm current, extends along the coast and its headlands as far north as the 36th parallel of latitude. The forest flora of this region includes not less than 40 genera and 80 species of trees, of which 24 genera, comprising 52 species, are natives of Japan. Of conifers 4 genera, comprising 7 species, are typical of the region, and of these 1 genus and 2 species are found in Japan, while two other genera, comprising 2 species, of which 1 genus and 1 species belong to Japan, take the place of broad-leaved trees.

(3). *The Warm Temperate Region.*

In the northern part of the subtropical region deciduous trees are mixed with evergreen. Further north the former begin to prevail, while the latter are reduced to a small number of scattered individuals, or even to mere shrubby undergrowth; here we enter the great forests of deciduous trees which constitute the warm temperate region.

This region is well-developed in the Northern Hemisphere, especially in Eastern North America, in Eastern Asia and in Europe, two-thirds of which belong to it; whereas in Western North America on the Pacific, with its high mountains and vast prairies, only the vicinity of the coasts and rivers is adapted for broad-leaved trees, which are, moreover, mostly replaced by conifers.

The Atlantic forests of deciduous trees have their northern limit beyond the United States in Canada. Towards the south as well as the north, on dry sandy or gravelly soil, pines replace the broad-leaved trees, which require a richer soil for their existence, while in places too wet for *Angiosperms*, *Gymnosperms* like *Tsuga* and *Chamæcyparis*, and even a stunted growth of firs, spruces and larches, which belong to the next more northerly region, may replace the typical tree-flora.

In my various travels round the globe, I have not observed any forests of deciduous trees to compare with those of the Atlantic region of the United States in the number and value of their individuals.

It has generally been held a sufficiently established fact that, with the sole exception of tropical forests, those of Japan excel the Atlantic forests in richness of genera and species, and also in the beauty of their autumnal tints. But a careful investigation of Japanese tree-vegetation and its biology, of which, however, so

little is as yet generally known, and many opportunities of observing their autumnal tints, lead me to the conclusion that sufficient credit on both points has not been given to the Atlantic forests of the United States.

According to Professor Sargent's well-known report on the forest trees of the United States, the forests of the Atlantic belt contain not less than 61 *genera*, comprising 154 *species*, of deciduous trees, which attain a height of over 8 metres ; while the Japanese flora of the same region contains 64 genera and 132 species ; so that the latter includes about the same number of genera, but falls considerably behind the flora of the Atlantic coast belt in respect of the number of deciduous species.

It is clear that until now something must have been overlooked, otherwise the true state of the case could not have remained hidden so long.

It is true that if we take the trees of both the subtropical and warm temperate regions together (a grouping that is of little practical and scientific value, as the trees of both regions mix only on the boundary between them), then the Atlantic forests comprise 70 genera with 165 species, and those of Japan 88 genera with 184 species, taking *Angiosperms* alone into account. But if we adopt the plan of comparing a forest in a particular region in one country with the forests of the corresponding region in the other—and we cannot justly do otherwise if we wish to compare and form an exact idea of forests actually existing in nature—we shall see that the greater richness in forest trees of the Japanese flora holds good for the subtropical region, but by no means for the warm temperate region. I need hardly add that the Japanese flora is very rich in numerous shrubs, which do not attain a height of over 8 metres, and are, from a practical stand-point, more or less insignificant.

In Europe the forests of the warm-temperate region are composed of 29 genera and 66 species, while the Pacific flora of the corresponding region (the North Mexican flora of Western Texas, Arizona and New Mexico always excepted) contains 21 genera and 44 species only, and is consequently poorer.

If we compare the number of typical conifers which replace broad-leaved species in different parts of the globe, we obtain these results—

	Genera.	Species.
Atlantic belt, ...	7	16
Pacific „	11	18
Japanese region, ...	12	19
Europe, ...	3	9

4. *The Cool Temperate Region.*

Within this region dark-green coniferous trees, such as firs and spruces, predominate. The climate differs from that of the preceding one as being more exposed to extremes of temperature and less to extremes of humidity, which is relatively higher than in the warm temperate region; there is more rain and snow, and the whole region may be characterised as more or less uniformly cool, damp, foggy, with a long period of rest for vegetation in winter. Such is the climate where spruces and firs are found wild in Europe, America and Asia.

Within the Atlantic belt only the highest peaks of the Alleghanies, Andirondacks and White Mountains bear considerable patches of dark green forest, but north of the United States, in Canada, the forests of this cooler region prevail on a vast scale.

The Pacific coast, owing to the great number of high mountains, contains extensive tracts of forests belonging to this region, which reach their largest development in Columbia and Alaska.

Within the three large islands of Japan, Kinshin, Shikoku and Hondo (Nippen is not the largest island, as is generally believed in Europe and America, but merely the native name for the whole empire), that region is limited to the higher mountains, and on the northern island of Eso (often corrupted on maps into Yesso) the firs and spruces extend down to the sea-level. In Europe the forests of this region descend to the sea level from the 60th parallel of latitude in the North-West and from the 58th parallel in the North-East. Thus, inclusive of the mountain forests of the preceding warmer region, about one-quarter of the land surface of the northern hemisphere is under fir and spruce, or at least was covered by those trees before man's appearance on the scene.

Within this region the conifers alone attain their maximum. Their number may be put down at—

	Genera.	Species.
In the Atlantic belt, ...	4	6
„ Pacific, ...	6	16
„ Japan, ...	4	10
„ Europe, ...	4	10

It is remarkable that four genera (*viz.*, *Pinus*, *Picea*, *Larix* and *Abies*) are found in Europe, Asia and America, thus being circumpolar. The Pacific coast alone possesses two additional genera, *viz.*, *Chamæcyparis* and *Tsuga*.

If we class together all the coniferous trees of the sub-tropical and the two temperate regions—a proposal often discussed, but of little practical or scientific value—we find—

	Genera.	Species.
In Europe, ...	8	20
On the Atlantic coast, ...	13	26
In Japan, ...	17	32
On the Pacific coast, ...	22	46

The genus *Pinus* deserves special consideration. Most pines seem to be substitutes for other trees for which the soil is too poor, especially when dry, gravelly, or sandy.

For botanical and economic purposes it may be advisable to distinguish in the East a "Southern Maritime Pine-Belt" and a "Northern Pine-Belt," and perhaps also an "Atlantic Coast Pine-Belt." But for biological considerations, which are indispensable when the preservation, management and cultivation of a forest are in view, it may be useful to bear in mind that the southern maritime pine-belt occupies the boundaries of two natural regions, *viz.*, the sub-tropical and warm temperate, so that the pines of the southern part of the belt (*P. cubensis*, *clausa* and *seratina*) form substitutes for the evergreen broad-leaved trees, while the pines of the northern half (*P. australis*, *Tæda*, *mitis* and *glabra*) form substitutes for the deciduous trees of the south. In the same way the northern pine-belt lies on the common boundary of the broad-leaved deciduous trees, and of the firs and spruces, thus replacing the trees of both regions. Lastly, the Atlantic coast pine-belt (between the two others) replaces trees of the warm temperate region only.

The forests of the United States are extremely rich in pines, to the number of which the present writer has been able to add one more, which Professor C. S. Sargent has described as a new species. It is most certainly a recent addition to the flora of the United States, and belongs to the North Mexican flora, as it was found, in December, 1889, on the southern slopes of the Santa Rita Mountains in Arizona. However, Mr. C. G. Pringle, also an authority on North Mexican trees, declares it to be identical with the *Pinus Engelmanni* of Mexico. It is remarkable that, so far as my experience goes, scarcely a single pine grows within the tropics. The pines of Burma, India and Sumatra are by no means within the tropics, but, owing to the elevation above the sea at which they grow, in a region that is semi- or sub-tropical, although a few patches of the Khasia or the Sumatra pine may occasionally enter the tropics.

Within the *Sub-tropical Region*—

Japan has	1 pine.
Europe, ...	1 „
The Atlantic coast, ...	8 pines.
The Pacific coast, ...	6 „

In the *Warm temperate Region*—

Japan has	.. .. ..	4 pines, (including the one
The Pacific coast,	.. ..	6 „ in the sub-tropi-
Europe,	.. .. ..	7 „ cal region).
The Atlantic coast,	.. ..	9 „

Inside the *Cool temperate Region*—

Japan has	.. ..	1 pine.
The Atlantic coast,	.. .. ..	1 „
Europe,	.. ..	2 pines.
The Pacific coast,	.. .. ..	5 „

Europe has 10 pines altogether, while the Atlantic belt has 13, the Pacific belt 17, and the North American belt (within the United States) 8, being a total of 38 for the whole of America. The poverty of the Japanese flora in pines (5 altogether) may be explained by the fact that only in some places, immediately bordering on the coast, and on the mountains of granitic formation in the interior, is the soil so poor and dry that no other trees but pines can grow.

II. The Prairies.

The meteorological observations of the United States recorded in the annual publications on the subject are unsurpassed in completeness by any of the reports of the Meteorological departments of Europe. From these observations we can deduce the climatic characteristics of the vast prairies. I mean no aspersion when I express the wish that the meteorological stations in the West may be considerably augmented in number, so that several new ones may be located within the forest regions of the mountains which possess such different climatic characteristics and lie so close to vast prairie tracts.

On the East the moist winds from the Gulf and the Atlantic can easily enter the continent, bringing with them sufficient moisture to cause enough rainfall for an enormous belt of forests.

In the West the moist winds from the Pacific, in blowing over the continent, impinge several times (below the 42nd parallel of latitude), against lofty ridges running parallel to the coast, and each time parts with a portion of their moisture.

The effect of these successive parallel mountain ranges upon the moisture of the wind, and consequently upon the vegetation, is well illustrated by the following facts and observations :—

The moist ocean winds ascending up the Pacific slope to the

crests of the first range of mountains (the Coast Range) get cooled as they ascend and give rise to a belt of uninterrupted forest. This forest belt ceases at the average height of the passes, for the wind having now to descend, becomes warmer as it descends, and hence relatively drier. Fog and rain, therefore, are no longer produced, and prairie only can exist. On the second, the Cascade Range, the wind again becomes an ascending current, and although it has already parted with some of its moisture on the first range, still contains enough to nourish prairie growth *up to the same elevation as the passes of the first range*, above which height, however, as it gets further cooled and relatively moister, it causes forests to reappear. It is a noteworthy fact that on the intermediate minor ranges there will be only prairie if they do not rise above the height of the passes of the first range; but if any of their summits exceed that height, these will be forest-clad from being inside the upper stream of moist air. On the third range, that of the Rockies, the forest line begins at the average height of the passes of the second range, and the forests extend upwards until the temperature becomes too low for tree-growth. The intermediate minor range of the Blue Mountains is covered with forest only from the level of the passes of the Cascade Range. Beyond the Rockies we find only prairie until we reach the westernmost edge of the area under the influence of the moist winds from the Gulf and the Atlantic ocean.

From observations made in North America, and in Europe and Asia, we deduce the following law :—*Forest growth ceases where the relative humidity of the air during May, June, July, and August no longer attains* 50 *per cent., or where the rainfall during that period is less than* 50 *mm.* (2 *inches*), *or where frost occurs in each of those months* (*a region marked by the annual isotherm of* 0°*C.*) Regarding the North American prairies in the light of this law, we observe that the prairie situated east of 95th meridian West receives during the four months in question more than 200 mm. (8 inches) of rain, while the air contains more than 60 per cent. of relative humidity, and the mean annual temperature stands well above 0°C. These characteristics are a certain indication that this portion of the North American prairie has once been under forest; and that forest can again be introduced there has been fully proved.

From 95° West Longitude westward to 100° the relative humidity, as recorded, is above 50 per cent., and rain and the temperature seem to be sufficient for forest growth; but we must bear in mind that the meteorological stations from which these data are derived are situated in rich sheltered valleys, well-watered by

rivers—circumstances which must considerably raise the relative humidity. More accurate knowledge of the climatic characteristics of the high prairies are required before we can determine the natural boundary of forest growth on the west.

Between the Rocky Mountains and the 100th meridian the relative humidity falls below 50 per cent. Forest growth is therefore impossible, and in fact most of the prairies between the Rockies and the Cascade range suffer from want of rain and relative humidity. The Californian prairie is, however, an exception to the rule, as the relative humidity (above 60 per cent.) is sufficient for forest growth; but the amount of rainfall during the four summer months is less than 50 mm. (2 inches).

For practical purposes the prairies of the United States may be divided into three regions as follows :—

I. PRAIRIES EAST OF THE ROCKY MOUNTAINS, which may be thus sub-divided—

(*a*). The *Northern or Grass Prairie.*—It is due to the low relative humidity during the four principal months of growth. Still it is sufficiently well-watered. It has been, and is still being, greatly added to on the east by fires. Agriculture is practicable throughout; forestry only east of 100° West Longitude.

(*b*). The *Southern or Shrub Prairie*, west of 100° West Longitude.—It is unfit for forestry; for agriculture irrigation is necessary.

II. THE PRAIRIES ON THE NORTH AND SOUTH BETWEEN THE ROCKY MOUNTAINS AND THE CASCADE RANGE (SIERRA NEVADA). —Owing to want of rain and deficient relative humidity of the air forest growth is impossible. Away from the river valleys, even agriculture, helped by irrigation, is doubtful.

III. THE PRAIRIES BETWEEN THE SIERRA NEVADA AND THE COAST RANGE.—This is in the Californian valley. Rain is deficient during the season of vegetation, although the relative humidity of the air is sufficient for forest growth.

It may not be far from the truth to say that all grass prairie is *the* locality *par excellence* for raising cereals, which are, after all, nothing else but grasses. The question as to what kinds of cereals can be profitably grown depends upon other factors.

It may be mentioned as a fact of practical value that the height of trees does not depend solely on the quality of the soil, as is laid down in some European text-books on forestry, but also on the humidity of the air. In localities with an average relative humidity of above 60 per cent., we may safely expect that forest trees will grow to a height of 25 m. (83 feet) and more. When

the relative humidity during the period May—August does not exceed 60 per cent., the height of the trees, which must be planted, will diminish in geometrical progression as the percentage sinks to 50, the limit of tree growth. There can be no doubt that fruit trees will grow wherever ordinary broad-leaved trees can do so, and it is to be hoped that small-sized fruit trees may be grown with irrigation beyond the limit of forest growth, that is, in localities with an average relative humidity of less than 50 per cent.

TOKIO, *July, 1889.* DR. H. MAYR.

THE COMING CHANGES WITH RESPECT TO THE TRAINING AND FIRST APPOINTMENT OF FOREST OFFICERS SELECTED IN ENGLAND.

FROM the excellent paper read by Dr. Schlich before the Society of Arts and published in another part of this issue, our readers will have observed that the following changes in the training and first appointment of our Junior Assistants have been sanctioned by the Secretary of State, and will come into force with the entry of the next batch of probationers into Cooper's Hill :—

(1). Course of training extended from twenty-six to thirty-four months, so that no Junior Assistants will join us at the end of 1892.

(2). Initial pay of a Junior Assistant raised from Rs. 250 to Rs. 350.

In addition to these two changes the limits of age for entry into Cooper's Hill will, from 1891, be 17 and 20 years respectively, instead of 17 and 21, and from the same year a new scheme of subjects and marks for the competitive examination, based on that of the "Further Examination" for Woolwich, will be devised.

Changes (1) and (2) and the improvement of the scope and standard of the competitive examination are a move in the right direction, and one that has been urgently called for from the very beginning.

It has been a common complaint on the part of those who ought to know that, for many years past, both the number and quality of the candidates appearing at the annual competition have fallen off very considerably. When the European system of training was first established, the glowing prospectuses and advertisements scattered broad-cast over the face of the country by the Secretary

of State, entrapped many young men into presenting themselves for competition, who had before them far more promising careers than the Indian Forest Department could *really* offer them. Thus for the first few years the Secretary of State secured into his net candidates most of whom had received the best education that could be got at the Public Schools and Colleges. Such men could not fail to acquire at the Forest Schools and in the model forests of the Continent the knowledge and ideas which, after a few years of Indian experience, were to make them thoroughly competent Forest officers for this country.

But it was not long before the gilt fell off the ginger-bread. The men of 1872 and 1873 had to remain low down on a long supernumerary list until the beginning of 1876; and not only this, but as until 1875 promotion to the 2nd grade of Assistant Conservators depended entirely on the occurrence of vacancies, these officers vegetated for years in the 3rd grade, and not a single one of them attained to the 1st grade before 1st July 1880—8 years to become Assistant Conservator, 1st grade, on the magnificent salary of Rs. 450 a month!

Add to these wretched prospects the hard work, practical banishment from society, constant locomotion, the discomforts of eight to ten months' camp life in remote wild places, and exposure to serious risks to health. No wonder, therefore, that young men, as well as their parents, fought shy of such a career as long as there was even a less lucrative one open elsewhere. Matters have come to such a pass that various devices have had to be adopted in manipulating the marks in order to secure the number of qualified (?) candidates advertised for, such as grouping several subjects under one head that used to be distinct before. Indeed, in some cases, even after manipulating the marks, the required number of candidates could not be brought up to the qualification standard, and men had to be taken who had completely failed to qualify.

Merely, therefore, in order to attract more and better candidates to the competition, it was necessary to improve the initial prospects of the successful men. But since 1881 the establishment of the Dehra Dún Forest School has made this necessity still more pressing.

The object of that School is, as all our readers are aware, to prepare Executive Forest officers, *viz.*, Rangers and Sub-Assistant Conservators. Such officials are usually in charge of Ranges and, in exceptional instances, even of Divisions. Now the duties of a Range officer correspond exactly with those of a *Garde Général* and *Inspecteur Adjoint* in France and of an *Oberfoerster* in Ger-

many, so that our Rangers and Sub-Assistant Conservators must be thoroughly versed in sylviculture and in the utilization and protection of forests; and the professors and teachers at Dehra Dún accordingly do their best to work up to this requirement. Such being the case, the officers of the Controlling staff, the departmental superiors of Rangers and Sub-Assistants, cannot justify the position they hold unless they prove themselves to be the superiors of these latter in professional knowledge and general scientific attainments also. In order that they might do this, three conditions are essential—(1) they must have had a thorough general education, (2) they must have proved themselves to possess high natural abilities, and (3) they must be given the very best professional education that can be provided.

We are thus naturally brought face to face with the question—"To what extent has the present system of forest education at Cooper's Hill been able to replace the continental one which preceded it?"

In dealing with this question, we must remember that Cooper's Hill is primarily and principally an Engineering School. In grafting the forestry curriculum on the original one of engineering, the latter has not in any way been modified for the benefit of the other. Hence, where the two courses run on the same lines, the forestry one has to go too far in some respects and does not go far enough in others. The result is inefficiency as well as loss of time. This loss of time has more serious consequences than at first sight appears, for it takes away from the total number of hours which ought to be devoted to the branches of forestry proper, gives a false importance to certain subjects, and makes the daily programme of work seem a full one. It is, no doubt, in a great measure due to these three circumstances that the absurdity of having only a single Professor of Forestry has so long been tolerated. It is perfectly impossible that one man can effectively teach to two classes a subject so comprehensive as forestry.

Another drawback from which the Cooper's Hill training has suffered, and must continue to suffer for the next twenty years at least, is the absence of model forests and model operations in the neighbourhood. It is the opinion of all experienced teachers of forestry that unless the teaching in the lecture room is *at once* practically demonstrated in the forests, the average student is unable to follow it in all its bearings, and will often conceive very imperfect and misleading mental pictures of the phenomena or operations discussed and fill his mind with totally wrong ideas. Once such ideas formed, they are very difficult to eradicate, even

in daily sight of examples to the contrary, to which the warped mind has become purblind.

We cannot, therefore, but confess that the present system of training our Junior Assistants, so far as it is a substitute for the system it has replaced, has been a failure, and we have great cause to be thankful that measures are now at last to be taken to improve it. If a sufficient number of good competitors can be attracted, the improved scheme of entrance examination will give us the stamp of men required ; and the addition of eight months to the period of training and the probable appointment of a second Professor of Forestry will afford the opportunity of remodelling and expanding the scheme of instruction and making it more practical and thorough. Of the thirty-four months of the course, twelve at least should, in our opinion, be spent in Germany. A preliminary probation of some months spent in Germany in some instructive forest area, where the students will have an opportunity of seeing the various principal operations carried out and the effects of those made in preceding years, is to be recommended. Without such probation the students will not be able to derive the full profit from the courses of lectures held at Cooper's Hill. In former years, the men who went for their training to France passed a probation of this kind for six months before joining the Forest School at Nancy, and many of them owe to that probation the success which they subsequently attained in their studies.

The best plan of all would, of course, be for the students to spend the first year in England in studying book-keeping, surveying, engineering, chemistry, mineralogy and geology, and the various branches of botany, the remaining twenty-two months being passed in Germany in learning forestry, forest jurisprudence and land tenures, forest zoology, and accounts and procedure. But such a plan would mean the abandonment of Cooper's Hill as a Forest School.

One point in connection with the teaching of sylviculture and the organization and management of forests we cannot insist on too strongly. The instruction must be given mainly with the object of turning out good Forest officers for India, and hence the teachers must be men of long Indian experience. By all means let the men be taught thoroughly the theory and practice obtaining in Germany ; but even in teaching these the extent of their application to India must be fully discussed and brought out by the teacher. Many things can, and ought to be, done in Germany which, however, it would be madness to attempt in India. The teacher should be fully cognizant of these and be able to inform the

students accordingly. We, therefore, trust that our students will not be left to the sole guidance of a German Professor, be he ever so eminent in his own country ; and we also earnestly hope that the Secretary of State will not be advised into appointing a German to the proposed second Professorship of Forestry.*

We have already insisted on the necessity of giving our Junior Assistants as complete and high a professional education as possible with the means at our disposal. Hence we would strongly advocate that the young officers, on arrival in this country, should be placed under the principal professor of forestry at the Dehra Dún School, who would take them, from November to the beginning of the summer rains, to the most instructive forests of India and Burma, and, as it were, "finish" them in Indian forestry. It must be confessed that the progress made in Indian forestry during the twenty years since the Department has been properly organized, has been totally incommensurate with the time and money spent or the opportunities at our disposal. This want of progress is, no doubt, to a very great extent, due to the extremely low value (we might almost say none at all) set by Government on proficiency in forestry. So slight indeed is the inducement held out to its foresters by the Government to attain excellence in their profession, that we will offend no one when we say that not one in 50 members of the department ever attempt to keep abreast of the great progress that is being made in every branch of forestry in Europe. It is a standing reproach to us that after 20 years of organized existence we are still groping in the dark as to what methods of treatment we should apply to our different classes of forest, how deodar should be raised artificially, what principles and form should be adopted in framing our working plans, and so on. Truth to tell, if we are to be judged solely by the results we have been able to achieve, we might long ago (from the time that our distinguished founder, Sir Dietrich Brandis, set up the Department on a permanent footing) have given up the expensive training in Europe and placed at the head of each Circle a shrewd junior civilian or an ordinarily sagacious merchant's assistant or bank clerk.

So far as we have considered the coming changes, they are extremely satisfactory ; but we are afraid that, unless the Secretary of State is willing to open his purse strings a little more, they will be fruitless of result. Already under the present system the pressure on the finances of parents is very heavy. The cost of the Cooper's

* Since this article has been in type we have received information that this post has been offered to our colleague, Mr. W. R. Fisher.

Hill training, inclusive of College fees, books, and other items, is not less than £250 a year. The additional period of 8 months will thus increase the total cost by at least £170. Few parents will perhaps be able or care to bear this large extra burden. The raising of the initial pay from Rs. 250 to Rs. 350 is no concession at all, for under the present system most of the Junior Assistants qualify for promotion to the 2nd grade within 12 months of their arrival, and in the meanwhile receive Rs. 250 a month, instead of (as the new men will have to do at Cooper's Hill) spending nearly Rs. 300 a month. Pecuniarily, therefore, the new men will be much worse off, the extent to which they will lose being as under, 12 months being taken as the average time in which the men at present gain their first step—

	Rs.	Rs.
12 months' pay at Rs. 250, ...	3,000	
6 months' travelling allowance at Rs. 100, ...	600	
£170 (as above) at 1*s.* 6*d.* per rupee, ...	2,300	
		5,900
Deduct—4 months' pay at Rs. 350, ...	1,400	
„ 3 months' travelling allowance at Rs. 100, ...	300	
		1,700
Net loss, ...		4,200

Thus the net loss will be Rs. 350 a month for 12 months. Surely the Government of India, who proposed the change for acceptance by the Secretary of State, forgot to make a very small calculation, which, however, was important enough to render its omission likely to completely defeat the object of the change. There is still plenty of time to remedy the mistake, and we hope that the probationers will be at least granted a stipend for the last 8 months of their training in Europe at the rate of two-thirds of Rs. 250 a month ; otherwise the number and quality of the candidates presenting themselves for competition will continue to fall off and the Indian Forest Department will be considerably worse off than it was before.

In proposing and accepting the new measures as they have been passed, the Government of India and the Secretary of State no doubt argued that because Rs. 350 a month initial Indian pay, without any stipend during the 3 years at Cooper's Hill, has sufficed to attract good men into the Public Works Department,

therefore the same inducement would suffice also for the Forest Department. But they forgot that—

1. Whereas the Public Works Department rates of pay are—Rs. 300, 400, 500, 600, 700, 800, and 950, ours are 250, 350, 450, 550, 650, 800, and 900.

2. For every one Conservator we have, the Public Works Department have at least three Superintending Engineers.

3. Whereas the pay of Conservators ranges from Rs. 1,000 to 1,500, that of Superintending Engineers ranges from Rs. 1,100 to 1,600.

4. As compared to our one Inspector-General, the Public Works Department have not only more than a dozen Chief Engineers, but such other special appointments as that of Consulting Engineer to the Government of India for State Railways, Inspector-General of Irrigation, Director-General of Railways, Directors and Managers of State Railways, &c., most of them carrying a higher salary than the average salary of our one prize appointment.

5. The Public Works Department have more favourable pension rules.

6. Engineers can also enter their Accounts Department and the Traffic and Locomotive Departments of the State Railways, in all which branches the pay and prospects compare favourably with ours.

7. An Engineer can adopt a lucrative private career when he leaves Government service, whereas a Forester must go on the shelf once he is superannuated, and if he has a grievance against Government, resignation means starvation.

PERIOD OF YEAR FOR SUBMISSION OF DIVISIONAL ANNUAL PROGRESS REPORT.

HAVING just emerged from the throes of the Annual Report and while still intoxicated with the exuberance of my own verbosity, I think it a suitable moment to raise the question of the period for which Forest officers are called upon to report. The financial year, as we know, extends from the 1st April to the 31st March, and we report on that period, but surely everyone will agree that it is very unsatisfactory. The real working year for the great majority of Divisions is from rains to rains, and it would consequently be a much better picture of the actual progress made (is not the Report called a "Progress Report?") were the 30th June or 15th July taken as the end of the year. I believe I am right in saying that some Departments have a different financial year to the ordinary one, and the Forest Department

is emphatically badly fitted to the ordinary year. Thus in my own Circle the fact of heavy winter rains will throw thousands of rupees into the following year by interrupting export, and the working season not being completed and everyone being plunged in heavy current work at the moment, the greatest difficulty is experienced in getting the expenditure charged off into the right year. The Yield Forms show much outturn from the previous year, while the "trees felled" have been shown without their outturn in the previous year, and similarly the year under report shows many trees felled without any outturn. My own report for this year is a good example, for I had to show some Rs. 7,000 of expenditure for work actually done the previous season. If the date I propose were adopted, the revenue and expenditure could all be accurately charged off to the actual working year, the forms made out correctly, and the Divisional officer and his office could sit down to the report at a period of comparative rest from current work and fires—and also of comparative coolness.

If, however, the idea of altering the financial year is impracticable, we could still adhere to that system as far as the Finance Department were concerned; but for the purposes of our Annual Report give the figures to the end of June or 15th July, as we actually do for Fire Conservancy—this would not present any real inconvenience that I can see.

One objection might be raised to this proposal, namely, that leave is taken in the rains, so that a new man would have to write the Report; but apart from the fact that local Governments are generally so "*tang*" for men that much privilege leave is not given, this would not be a real objection, because the Report would be finished within July, and there would then be three rains' months left for privilege leave. Furlough, moreover, is generally taken at the beginning of the hot weather, so that the new Divisional officer writes the Report.

5th May, 1890. Q.

What "Q" says cannot but have struck many others, and even the powers that be themselves; but we fear red tape is too strong to give hope for a reform. We have a case in point in the Forest Survey Branch, the Annual Progress Report of which deals with the period from the beginning of the field season to the close of the ensuing recess season during which the results of the field work are worked up. "Q." however, forgets that if Divisional officers have to write their reports at a most inconvenient season of the year, this very fact enables the Conservators to compile and pass through the press theirs during the leisure, and in the midst of the comforts of the recess season. So we are afraid that "Q." and other Divisional officers like himself must continue to write their reports as at present, until the wheel of time and fortune lands them into a Conservatorship.—[Ed.]

THE GRAZING QUESTION—WHAT IS A FOREST ?

I UNFORTUNATELY have not a copy of the report of the Dehra Dún Conference to refer to, but I think I am right in saying that it was almost unanimously resolved that where grazing is in demand it was the duty of the Forest Department to furnish the maximum quantity compatible with the well-being of the forest growth. Moreover, the sense of the meeting was decidedly that in almost every forest pasture could to some—mostly to a very considerable—extent be so provided. So that while heartily agreeing with the dictum of "G. K. B." in your September Number, that "the chief end and aim of forestry is to produce timber, and everything else should be made subsidiary to this," I do not agree with him that "grass in a forest is out of place," or that (granted that the Forest Department must furnish pasturage) we should "keep the two things distinct—forests as forests, pastures as pastures : forest and pasture in one and the same place are incompatible with one another." To decide where, when, and to what extent pasture may be allowed in forest is, or rather should be, left absolutely in the hands of the Forest Department ; but this only increases the responsibility laid on that Department to provide the maximum possible quantity.

It is not my intention to discuss the advantages and disadvantages of the proposed system of regularized or modified jardinage as it affects *timber*, though in judging even of these it seems to me the low standard of education of our Executive staff is a factor which has been overlooked. I would point out, however, that this system can never furnish the maximum of pasturage. Where jardinage pure and simple is the ruling system, it stands to reason that no grazing of any kind can ever be allowed in the forest, for there will or ought to be reproduction going on all over the forest. The more the jardinage is localized and intensified, *i.e.*, the smaller the proportion of forest submitted to jardinage in each year, the greater the area which can be made available for pasture, but under no circumstances can this equal the amount which may be made available under the "Regular System." Personally I hold this view of the question so strongly, that I have, wherever possible, substituted fellings *à blance étoc* followed by artificial reproduction for the jardinage which I found in force. The artificial reproduction adds, no doubt, to the cost of working ; but then the increased revenue from pasture and fodder balances this—if not altogether, at any rate to a great extent—and, after all, Government being the "owner," the money return is not to be balanced for a moment against the increased pasture and fodder made available.

Of course, Mr. Editor, I do not for a moment pretend to say that clean cutting is everywhere to be substituted for jardinage or anything else. In the circumstances with which I have had to deal (*viz.*, an enormous demand for grass and grazing and favourable conditions for artificial reproduction), I believe I have done right, but as there is no universal medicine, so there is no universally applicable system of working. I think, however, wherever there is a large demand for pasture, the preponderating advantages expected from the adoption of jardinage must be very marked indeed, before it is adopted in preference to other systems which make available a greater quantity of grazing.

Before sitting down to write these lines, I thought I would seek inspiration from Schlich's Manual of Forestry. I hope some Forest officer with leisure will shortly give us a careful notice of this book. Just now I would call attention to the following :—

At page 6, forest is defined as "an area which is for the most part set aside for the production of timber and other forest produce, &c., &c." Again at page 99, amongst the objects for which a forest may be maintained, we find "(2) to produce the greatest possible quantity of wood, or other produce, per acre per year." If these extracts are to be read literally, the wording is dangerously loose, seeing the importance of the subject-matter. For instance, in the first case, when the "most part" has been set aside for timber production, what is to become of the rest? Reading the two together, however, it seems to me that "for the most part" means "usually," and hints at the "or other produce" of the second extract, in which it is not inaccurate wording, but startling theory which makes forestry include all the "cultures." For take object "(2)" and for "other produce" substitute "cabbages," and we have "horticulture" or "corn" and we have "agriculture." If this is Dr. Schlich's meaning, then "G. K. B." has the authority of the Principal Professor of Forestry at the Royal Indian Engineering College, Cooper's Hill, for his dictum, that we should "keep the two things distinct, forests as forests, pastures as pastures." Nevertheless it is not what I was taught.*

GHATI.

BARK-EATING ON THE PART OF ELEPHANTS.

FOR the first time in my experience in Burma I am working in a teak forest which is evidently, in certain seasons, the home of

* No one has yet succeeded in framing an accurate definition of the term "forest." Our own opinion is that the devising of such a definition does not in any way promote the forester's art, and is best left to the ingenuity of lawyers.—[ED.]

numerous wild elephants. The country is very rough with steep hill ridges all over the place. Along each main ridge is an elephant path, beaten hard by constant usage, and down every spur you will also find a path ; but these latter are not so well worn. Along with those of the elephant are numerous tracks of bison, buffalo, and sambur.

It is a grand forest for teak, but the most curious thing to my mind is the terrible damage that has been done to the teak trees by these elephants. Without exaggeration, nearly every tree you find has been more or less injured by the beasts, the exception being only the trees which are so placed as to be practically inaccessible. The elephants would appear to dig their tusks under the bark and rip it across, then pulling the bark off in strips with their trunks. I have seen many marks of the tusks left on the tree 8 feet from the ground, and the height from which the strips have been torn off is often considerably more than this. When the tree is not quite killed, the bark in time grows over the bared place ; but I noted one tree of about 4 feet girth breast high that had been completely killed and every vestige of bark within 7 or 8 feet from the ground removed. Only yesterday I found a tree of about the same size which would have been killed but for the accident of a small but fairly deep groove extending from the root high up the tree. In this was a strip of bark about 2 inches wide which the elephant had not been able to dig out, and which had sufficed to keep the tree alive.

There can be no doubt that it is the work of elephants and nothing else ; the Burmans say they eat the bark, but I never heard of it before, nor have I ever seen one of my baggage elephants touch a teak tree. I may mention that, with the exception of one Pyinkado (*Xylia dolabriformis*), I have not seen a single tree of any other species attacked in this way.

There is magnificent feeding for elephants in the lower ground all the year round, so it cannot be that they eat the bark of the teak for want of better food. Nor can it be the work of the timber contractors' elephants, which, being hobbled at night, might be supposed to have less choice of food, for the forests have never been worked except in a small way some years ago with buffaloes.

Can you inform me whether this vicious trick on the part of wild elephants has ever been noticed before ?

CAMP NEAR KAMPAT,
UPPER CHINDWIN :
15th March, 1890.

H. S.

EDITOR'S REPLY.—In the Sub-Himalayan forests of the North-West Provinces it has long been a well-known fact that in the months of April and May,

when the new foliage is coming out and the trees are full of sap, wild elephants eat the sál bark medicinally. The fact is stated on page 34 of Fernandez' "Rough Draft of a Manual of Indian Sylviculture." The elephants prefer the bark of poles, which they can knock down, and which, no doubt, possess more tender and juicy bark than old trees. But not unfrequently the bark of strong standing stems is ripped off in the way described by "H. S."

The habit of always using certain well-beaten tracks is common also to the elephants in the Sub-Himalayan sál forests. These tracks are so chosen as to avoid very rough ground and all steep ascents and descents. In the Siwaliks forming the southern boundary of the Dehra Dún there is such a track on each side of the range, that on the northern side having been, after expenditure of very little labour, converted into a broad forest road. The local name for an elephant track here is *hati bair*.

THE ANAMALLAIS TRAMWAY.

THE subjoined extract from the "Madras Mail" will explain the position and object of the tramway and the circumstances in which it was constructed—

"The Anamallais lie to the south of, and some 400 square miles of them are within, the Coimbatore District. The forests are for administrative purposes divided into four ranges, and it is for the export of timber in "No. I. Range," with its appended "Leased Forests" (27 square miles) that the tramway has been laid. It is here that the teak is said to have its home, and with it are associated some of the finest specimens of blackwood, *Terminalia tomentosa* and *paniculata*, *Pterocarpus Marsupium*, *Lagerstræmia microcarpa*, *Anogeissus latifolia*, *Grewia tiliæfolia*, and *Briedelia spinosa*. The tramway, as at present laid, begins from about the outer ridge, and runs south-westerly inwards for seven miles, with a fall of from 1 in 20 to 1 in 10. At the outer ridge the logs are slipped down for half a mile, then carted to the foot of the hills (1½ miles) or taken into Coimbatore (44 miles) and sold. The cost of the tramway is put down at Rs. 56,000, the annual export of timber at 55,000 cubic feet, and the interest on capital (5 per cent.) and feed and keep of live stock are estimated to be more than covered from the saving effected over the old method of cart transport. The difficulties experienced in laying down the line may be gathered from the following extracts taken from the Proceedings of the Board of Revenue, dated 5th October last:—

"'The necessity for the services of an Engineer was abundantly evident, for the difficulties under which Mr. Porter, the District Forest Officer, was labouring were such as were insurmountable when problems demanding a professional training were worked out by the light of nature. The set curves sent out from England were nearly all used up, and they did not seem altogether suited for the work.

"'One of the greatest difficulties was to prevent the derailment at the curves. Mr. Porter had tried various experiments, and had finally adopted a super-elevation of the outer rail of over 4 inches. Unloaded trucks went fairly well over

the curves thus set, but there were accidents with loaded trucks Then there were difficulties about adjusting the curve.

"'The Engineer whose services were obtained from Calcutta was a Mr. Eden, a Mechanical Engineer. The first problem worked out by Mr Eden was that of super-elevation of the outer rail at the curves, and this he reduced to 1½ inches . . . One cause of derailment was an excessive widening of the rails at the curves. . . . Mr Porter doubts whether the flanges of the wheels are deep enough for sharp curves. Messrs. Fowler and Co.'s Engineer is reported to have stayed on the Anamallais for about a month, and during that time his services were properly utilized in laying down about two miles of the most difficult portion of the line and in clearing away many of the engineering difficulties experienced in its working.'

"It may be at once said that the line as laid down was owing to the derailments which still occurred, practically unworkable. It took as much as two days on the average to load and transport a load of 75 cubic feet of timber over three miles of the line. It then devolved on Mr. S. C. Moss, Sub-Assistant Conservator of Forests, recently placed in charge of the Range, and deputed to assist Mr. Eden, to make the line a practical success. This necessitated his altering and relaying the entire line with a result so far successful, that trucks are now loaded, transported, unloaded, and taken back the same day over three miles of the line with few or no derailments; and with a little more energy and activity two trips might, it is said, be easily made in a day."

Taking the first section or the first two miles of the line, where all the difficulty lay, seven deviation lines were taken involving the following changes :—

(1). There were 73 curves in the old line ; 53 curves were done away with, and, therefore, the chances of derailments were reduced by nearly 73 per cent.

(2). The length of the line has been reduced by nearly ¼th of a mile, and the saving effected thereby amounts to some Rs. 2,000.

(3). The gradients are less steep and more uniform, and many reverse gradients have been avoided ; and whereas formerly only elephants could be employed, bullocks also are now used for dragging the trucks.

The derailments that occurred may be traced to the following causes :—

I. REVERSE GRADIENTS AT A CURVE, *viz.*, where the line forms a V or an inverted V at the apex of the curve.—In the former case, either the fore-wheels are jolted off the rails in the direction of the tangent at the point where the gradient is reversed, or the hind wheels are lifted off the rails soon after the fore-wheels have passed that point. In the latter case, the fore-wheels, immediately the change of gradient is reached, are similarly liable to be lifted

off the rails high enough for the flange to get above the rails, and thus be no longer able to prevent those wheels from moving off along the tangent and becoming derailed. In both cases derailments are avoided by making the curve and some 15 feet in prolongation of it both ways longitudinally level, either by filling in or cutting down, as the case may be, and giving the outer rail and the prolongation at both ends a super-elevation of 2 inches.

II. DEFECTIVE ADJUSTMENT OF THE OUTER RAIL ON AN INCLINE.—In a curve on an incline there are two slopes to be considered—the longitudinal slope (along the length of the line) and the cross slope caused by the super-elevation given to the outer rail. The mistake made all along was in giving the outer rail an equal super-elevation throughout its length. If the super-elevation is the same throughout the length of the outer rail, it is easy to see that the longitudinal slope will cause the truck to incline on its hind wheels, and the cross slope on its inner wheels. There will hence be no pressure on the top outer wheel. This wheel will thus be lifted off the rail, and the height to which it will be lifted will depend on the steepness of the slopes and the load carried. Hence the super-elevation of the outer rail must increase towards the apex of the curve, where it should be greatest. Measurements were made on fifteen successive curves in the second mile, immediately after ten pairs of loaded trucks had passed over them without a single case of derailment, and the results are given in the following table, in the hope that they may be found useful by others :—

Running number.	Gradient.	Chord of Arc.		*Super-elevation at*	
				Lower end.	Upper end.
		Feet.	Inches.	Inches.	Inches.
1	1 in 20	14	5	2·75	3·25
2	1 „ 27	13	4	2	3
3	1 „ 17	26	6	2·5	4·75
4	1 „ 120	13	10	2·75	3·75
5	1 „ 15	13	4	2·75	3·75
6	1 „ 20	13	10	2·25	4
7	1 „ 17	27	10	2·75	4·75
8	1 „ 17	13	10·75	1·75	3
9	1 „ 10	13	10·5	2·5	3
10	1 „ 13	13	10	1·75	2·75
11	1 „ 10	13	10·5	1·75	2·75
12	1 „ 20	14	4·5	1·75	2·25
13	Level	13	10·25	3·75	3·75
14	1 in 12·5	13	11	3	4·5
15	1 „ 120	13	10	2·75	3·75

From the foregoing figures we deduce the following practical rules :—(*a*), that according to the sharpness of the curve and the cross slope the outer rail should have a super-elevation of from 2 to 3 inches at the commencement of the curve, the super-elevation being gradually increased up to the apex to the extent of 1 inch for every 14 feet of chord and diminished along the straight at each end, so as to cease in a length of about two trucks ; and (*b*), that, as the preceding rule is difficult to carry out on a *kucha* roadway, the curve, as well as a portion of the straight at each end should, whenever possible, be made level in the direction of the way, the outer rail being then given a super-elevation of from 2 to 3½ inches. In any case further safety is insured by adding a "wing" or "guard" rail to the inner rail of the curve. The groove thus formed keeps the flanges of the inner wheels in position and prevents all chances of derailment.

III. DEFECTIVE ATTACHMENT OF THE TRUCKS AND ERRONEOUSLY DRAWING THE TRUCKS BY THE DRAG-BAR.—The trucks are attached to one another and drawn by the drag-bar. Unless the drag-bar is rigidly attached to the truck like the shafts of a carriage, the pull exerted through it has little or no influence in turning or guiding the trucks over the curve. The trucks must be coupled together in the same way as railway carriages, and the yoke-pole or drag-chain should be attached to the front coupling.

IV. COUPLING THE TRUCKS TOO FAR APART FROM ONE ANOTHER.—The trucks should be kept as close together as possible consistent with free play—their length between the axles and their distance apart may together be made equal to the chord of the average curve. This enables the trucks to travel more or less on the same curve at the same time, and every truck as it enters upon and passes over the curve places the next one in a better position to clear that curve. This precaution is especially important when reverse gradients occur.

V. NOT GUIDING THE TRUCKS, AND UNEQUAL PRESSURE DUE TO BAD LOADING.—The trucks may be assisted in going round a sharp curve by altering the position of the logs as the trucks are moving on the curve. This consists in pushing the fore end of the logs towards the inside of the curve and the end behind outwards.

Unequal pressure on the trucks, when the logs lie more on one truck than on the other, results either in the trucks derailing or toppling over.

VI. INSUFFICIENT ATTENTION TO LUBRICATION.—The last but not least point is to have the trucks well oiled or greased, so as to give easy movements to the different parts. Special attention

must be given to the axle-boxes and to the circular plate over which the cross-bar revolves.

MOUNT STUART, 9*th April*, 1890. S. C. M.

THE RECENT REFUSAL OF THE SECRETARY OF STATE TO IMPROVE OUR PENSION RULES.

I NOTICE in the issue of the "Times of India" of the 17th instant a telegram pregnant with interest to all Forest officers of the superior grades. I allude to the refusal of the authorities at home to place the Forest Department on the same footing as regards pensions as those in the Public Works and Telegraph Departments, which is fulminated therein. Now, I was not aware that any movement of the sort adumbrated was in contemplation, and I fancy my ignorance was shared by all, or nearly all, the officers of the Bombay Forest Department. Why not stick together, "shoulder to shoulder, blade to blade"? It is the old fable of the old man teaching his sons the enormous utility of *combination* by means of the bundle of sticks. Unanimity, brother Foresters, is the secret of success in a case like this; and let us all pull together whether our lot be cast in the Punjab, in Bengal, in Madras, in Burma, or Bombay.

Then gie's a hand, my trusty friend,
And here's a hand o' mine,
And ye will be your ain pintstoup
And I will aye be mine.

If you are going to have another try on your side, you had much better get us in the boat too.

BOMBAY DISTRICTS, 21*st April*, 1890. G. K. B.

RESULT OF TEACHING IN ONE AND THE SAME CLASS CANDIDATES FOR APPOINTMENT IN DIFFERENT GRADES.

UNDER the heading of "The troubles of a Native Executive Engineer," "Indian Engineering" tells the following story:—

"The Executive and Overseer had been at the Poona College together. They were having a difference of opinion on a point of Surveying and the discussion was waxing warm when the Overseer broke in with 'But remember, Rao Saheb, I got the prize for Surveying at College.' If this is not true, it is 'likely,' as there are native Engineers and Subordinates in the Indian P. W. D. holding the same University and Collegiate qualifications."

How much truer is such a story likely to be of Forest officials trained under the present system at the Dehra Dún Forest School, where candidates for Sub-Assistant Conservatorships and for Rangerships attend the same classes, study up to the same standard, and must reach the same tests of qualification. A student at the Poona College of Science can secure appointment as an Assistant Engineer only by proving himself the best all-round man of his year at the examinations of the Bombay University for the degree of L.C.E. whereas the students of the Dehra Dún Forest School who obtain first appointments as Sub-Assistant Conservators have often been men that have been badly beaten by at least half of their class fellows, who, however, can aspire to nothing higher than the lowest grade Rangership, and cannot hope to become Sub-Assistant Conservators for the first third of their service at least. Such a *reductio ad absurdum* must, however, continue to exist until Government admit the egregious blunder they have made in organizing and maintaining the School on its present basis and give it at last a real and sufficient teaching staff. No amount of pompous Resolutions or office notes by omniscient Secretariat lions will remove the glaring anomaly until the School staff is strengthened and receives the justice so long denied it, and the system of patronage under which Probationary Sub-Assistant Conservators can still be appointed is abolished. What can be more derogatory to discipline and efficiency than to place under the orders of a Sub-Assistant a Ranger who has proved himself intellectually and professionally a far better man! Then again we have several men who obtained honours in passing out of the School, and who have served the necessary probation as Rangers to qualify them for promotion to Sub-Assistant Conservator. These men have been waiting for years till they have become almost hopeless, while in the meantime Dowbs have been pitchforked over their heads. You cannot get blood out of stone, nor can you get good work out of discontented and hopeless men.

TWO VERY NECESSARY CORRECTIONS.

We have to apologise to Mr. Fisher for a most stupid blunder on the part of the P. D., by which the sequence of that gentleman's arguments in his letter, printed in our issue of September 1889, was completely dislocated. The last two paragraphs on page 341, and everything printed on page 342, with the exception of the last six lines, should be read immediately after line 19 on page 344.

"Also line 23 on page 42 of our preceding issue should run as follows :—'branch, but more especially in one, *viz.*,' &c."

JJ. SHIKAR.

SOME REMARKS ON TITLES AND TIGERS.

SIR,—Though a junior I am elderly. Age and consequent experience may excuse or even render these remarks worthy of your notice. I read the "Indian Forester" regularly, or rather as regularly as you permit me to, and for years I have noticed that the promise of its title is never fully carried out. You give us forestry always, agriculture sometimes, travel seldom, and shikar never. Can you, and will you, with the consideration due to a constant subscriber, tell me the reason of this? Is it that the Forest officer with about 100 prescribed and 15 dozen unprescribed forms has otherwise enough writing to do, or is a union of forestry and sport incompatible? However this may be, I appeal to you to either alter the title of your magazine or to procure some shikar articles. I am sure many men could supply you with interesting and thrilling notes strictly founded on fact, though perhaps at first it would be better not to make any conditions.* Now the influence of fire conservancy on large game, their number, and habits must be considerable. We have enormous areas protected from fire which were formerly burnt over every year. This means there is cover and water at all seasons where formerly both were scarce, and it also means considerable change in diet of graminivorous animals; leaves and fruits must largely take the place of grass, for it is a slow and laborious occupation extracting the new shoots from the mass of unpalatable dry vegetation. The effect of this on deer of all kinds is most marked, and has certainly altered their habits as to locality, and I believe too, to a certain extent, their colour and growth of horn; but this is a subject which requires much research before anything definite can be said. The number of deer has not, I think, increased to any marked extent, but the number of tigers has most decidedly, whilst the number of cattle killed has probably diminished. From this I conclude that tigers profit by protection as well as deer, that they prevent deer from increasing too rapidly, and that as long as there is game available, they do not care for killing domestic animals. Of course, I can only note my observations over a comparatively limited area, but if others will do the same, we will arrive at some idea of how we are affecting the natural history of the country whilst improving the forest growth.

* We devoutly wish it was a fact that our brother-foresters were willing to give the readers of our journal the benefit of their numerous and varied experiences in the matter of sport. We, however, hope that "An Aged Junior's" allusion to the subject will now at last enable us to justify our title.—[ED.]

As above remarked, tigers have increased, and this is not extraordinary. Even if a fire-protected forest were opened to shooting in the hot weather it would be useless to look for a tiger in it; one place is as good as another where all is high grass and forest, and therefore few tigers get killed. I have no hesitation in saying that, at the outside, not more than three per cent. of tigers in this Division are shot every year. The increase in numbers is the difference between that and the percentage of births after deducting the deaths from natural causes, that is, if tigers ever die in their beds, which I doubt. The next fact worthy of note is that tigers are more frequently met with accidentally than formerly, and this, not only because they are more numerous, but because they avoid man less, and because, by preference, they frequent roads and fire lines which men also use for choice. The tiger has good reason for this: he avoids the dew and the labour and noise of crushing through the grass, whilst he has more chance of meeting deer which graze greedily on the new grass in such places. But these accidental meetings with man are not as a rule dangerous for the tiger. Then again as to locality. The tiger follows the game, and if the deer have altered their habits through stress of fire conservancy, so must he. In point of fact, in the winter months, when the grass is heavy and uneatable, the deer retire to those places where the grass is lowest and other food is offered. This especially applies to the spotted deer in these provinces. The stags, being in velvet in this season, would rather not run the risk of injury in long grass, and may then be found at elevations up to 3,000 feet, where the grass is thin and short. There too the tiger and his marks are most frequently found at that season. As the new grass springs up and parts of the forest are burnt or cleared, the deer descend and their parasite with them. Ultimately in the hottest weather he will be found in those shady water-courses at the foot of the hills, rarely outside the forest in heavy grass.

How different is this existence to what it was before the forests were closed and protected. Then the jungle fires, commencing early in the year, gradually restricted the tiger's shelter, till the commencement of summer found him with no retreat but a little grass and a puddle of water, his presence known to the inhabitants for miles around, compelled by hunger to feed on cattle, unable to catch the game in the burnt-up forest. And some scorching midday in May he was rudely awakened to face a line of elephants and batteries of the most scientific weapons, and there died like a hero or a cur according to his breed and disposition.

Personally I do not yearn for tigers: they are often disagreeable

when alive and invariably so when dead ; but in the Division I have the honour to administer, there is much fire conservancy and many tigers. Both increase annually, and the latter to that extent that I have lately had a military detachment to kill a man-eater, and my Conservator has desired me to draw up a light working-plan for the suppression of dangerous carnivora—a sort of thinning by departmental agency I presume. Thus, though glad—I may say eager—to avoid the brutes, yet I am, through the workings of fate, continually meeting them. Such a chance *rencontre* was the cause of the death of my last tiger ; and this I propose to relate merely because it shows the objectionable fearlessness and contempt evinced by a tiger for a Forest officer. Coming home one evening seated on a pad elephant, I took a short cut through a thicket of khair and creepers, when my elephant shied at some animal I could not distinguish. Thinking it might be a deer or a pig, I proceeded on my way, when after a short distance the elephant again shied, and looking down I beheld my last tiger at a distance of about 15 feet in the conventional attitude for a spring. I will spare you a description of his flashing eye and lashing tail. Suffice it to say that I felt in a hurry to get in the first blow, and did so by planting a bullet in his throat. Then extricating myself from the embraces of khair and creeper, I returned home, leaving the tiger to die alone. Next morning I found him 20 yards away, half sitting up, but very harmless—a most curious and uncomfortable-looking attitude, but I suppose he knew best.

Some time ago there was in the "Pioneer" an article of interest, entitled "A Mad Tiger." That animal had doubts cast on his mental condition because he followed the hunter and did not get killed ; but you will agree with me that my last tiger, which followed an elephant and did get killed, has much stronger claims to insanity. It seems probable that after a few more years of successful fire-protection tigers will not only permit the Forest officer to approach, but even systematically follow him with evil intent, and when these days arrive stagnation in promotion will cease, there will be no more 4th grade Deputies of 17 years' service, and even the post of Instructor at the School will be eagerly sought after! In these circumstances I shall probably not advocate heavy fellings in my tiger working-plan, nor will it be well to advertise my Division as a paradise for tiger-slayers.

There is safety in numbers, and my identity will be well hidden if I sign myself

AN AGED JUNIOR.

III. Official Paper.

THE INJURY DONE TO FORESTS BY SHEEP AND GOATS.

(*Continued from page* 94).

Mr. J. McKee, Deputy Conservator, Central Provinces, writing in the *Indian Forester* for October 1875, says :—

" Experiments have been carried out in the Central Provinces which seem to prove that in some forests the fact of admitting cattle, even in the small number of one head to 15 acres, will in four months completely destroy all seedling growths. The following is the account given :—' Two blocks of forests from which cattle had been excluded for four months, from 1st April to 31st July, were inspected about the latter date, when large numbers of seedlings of the better classes of timber trees were found in all directions and situations, although the rainfall up to that period had been much below the average. On the 1st August licenses were issued allowing 256 cattle to graze in one of these blocks, containing about 3,840 acres, some few plots of ground in which seedlings were present having first been hedged off to protect them from injury. The block was again inspected towards the end of November, when it was observed that the yearling plants had completely disappeared, except in those places which had been enclosed.' "

Mr. Shuttleworth, Conservator of the Northern Circle in the Bombay Presidency, makes the following observations :—

" The Director's expressed opinion would imply, as his arguments are directed to prove, that the grazing of sheep is not harmful to forests. It is certain that he will find no Forest Officer to concur with him in this view, and he will find many Revenue Officers and others experienced in farming and stock-breeding in this country holding to the contrary, despite all his contentions on the point.

" The Director apparently suggests that the grazing of sheep may be regarded as ' light grazing.' Now sheep in this country are not, it is true, heavy animals, but they cannot be considered to be light grazers, for they are exceedingly close feeders. The teeth of goats are especially poisonous to ligneous vegetation, but grazing by sheep in large flocks upon soil already deteriorating most rapidly accelerates denudation ;

hundreds of sharp split hoofs pounding on the same limited surface cut up the ground and everything upon it, and the animals seize the root-stocks of the grass with their teeth and pull the entire plant out of the ground. Whatever may be the opinion of the Director of Agriculture on the point, it is absolutely certain that reproduction of forests, natural or artificial, is entirely incompatible with sheep and goat grazing. Sheep and goats may, as has been said before, be admitted into 'defensible' forests in a forestry point of view. But forests are, in the Deccan especially, not maintained solely for the production of timber: pasturage and fodder are important factors in the local management of forests, and in this aspect of forest conservancy the admission of sheep and goats into the forests of the Deccan is to be condemned. To prove this assertion, I would mention that sheep were allowed to graze this year in certain forest lands in the Poona district where only horned cattle generally graze, and the result has been a number of petitions protesting that the sheep have fouled and destroyed the pasturage so as to make it useless for cattle. Again, the village officers of Sawantsar, in the Kopargaon taluka of the Ahmednagar district, complained bitterly to me, when they accompanied me into the reserve of that village, of the utter destruction of the pasturage of their cattle effected by sheep. They pointed to me the perfectly bare ground in the month of December and said—'The sheep have done this; they have uprooted all the grass and have deprived our cattle of grazing.'

"The Director cites further the Government Farm in Khandesh, where pasture land are regularly grazed and the progress in tree-growing compares very favourably with that made in the forest lands adjoining, where grazing is prohibited." But the Director has very unaccountably failed to notice that the Government Farm in Khandesh contains good deep soil which is to a very considerable extent under irrigation, while the forest lands are stony hills with comparatively little soil; that the grazing in the Farm is regulated and controlled, a limited number of well-fed animals being admitted for short periods at a time after the hay has been cut; that they are driven into their stalls at night, where they are supplied with abundance of excellent fodder; that the grazing is supervised by an educated and highly practical European expert assisted by a large staff resident on the spot, while the forest lands are exposed to an overcrowding rush of hungry, half starved sheep with no restriction as to time or season, and one Forest guard to look after several hundreds of acres. No doubt the Director refers to the Jowardi Reserve near the Khandesh Farm, which was at one time under the Superintendent of that Farm, and was then put into forests because it was valueless for grazing the Farm cattle. Seven years' closure of this property has shown the time it takes for an impoverished, denuded hillside to recover in a locality of a comparatively light rainfall; but

the condition of this reserve now in its grazing character is vastly different to what it was when the Farm had it. However, there is no comparison between it and the Farm: in the latter the root-stocks have joined together and formed a complete felt, springy to the tread; this is due to artificial irrigation and properly-regulated grazing. The Farm animals being stall-fed would naturally be much less destructive; but even admitting that the alleged superiority of reproduction on grazed areas over the ungrazed is an accurately observed fact, it would still be urged that a proposal to manage whole districts on the basis of a more or less successful result occurring with exceptional animals upon a small area of exceptional lands under exceptional conditions of treatment will not bear serious scrutiny.

"Lastly, is the statement of the Director that '*sheep will not graze unless led by goats.*' I have never heard before of such a remarkable fact, if it is a fact, which I greatly doubt; for I have kept sheep without any goats in this country, and they have always grazed to their fill. In the highlands of Scotland, where I have seen sheep grazing, and in the downs of England, where I have not only seen but have studied the industry, this phenomenal feature in the natural habit of the animals has escaped my observation, and to the extensive sheep-walks of Australia goats are, I believe, unknown. No doubt sheep are more easily managed when led by goats, for they follow blindly where it is hard to drive them. As a case in point, I may mention that sheep have swum across tidal creeks after my horse, and swim across rivers annually after my people in the course of my annual tours. Goats are the more intelligent animals, and where there are no dogs, such as the famed collies of Scotland, and shepherds are somewhat lazy, they include a certain number of goats in each flock to be leaders of it.

"Finally, I beg respectfully to urge that the grazing of sheep and goats in the reserved forests in the Deccan, which are still under reboisement, is as inimical to the interests of tree-growth as it is to the interests of grass fodder and pasturage, and that these animals, if admitted to any reserved forests, should be allowed entry into a few selected areas only; and I am of opinion that not the slightest harm would result to the sheep industry if all the forests were to be closed against them as grazing grounds if sufficient extent can be found for them outside the forest reservations at such seasons as the cultivation fields generally are not open to their entry and are not used for sheep-grazing."

The Divisional Forest Officer, North Thana, Mr. Wilkins, reports:—

"I am unhesitatingly able to say that it is fatal to allow goats into any kind of forests, for they eat up and destroy shoots and tender

seedlings. Cases I may say almost without number have during the present season come within my observation where goats which are kept by the wild tribes have cropped down and destroyed the young tender coppice-shoots of the trees felled in the compartments. The damage so done is very great and very difficult to repair: not only is the reproduction retarded for a whole year, but it necessitates the cutting back of all the damaged shoots—a work which involves a great deal of labour and expense and the most careful supervision."

The Divisional Forest Officer, South Thana, Mr. G. P. Millett, reports:—

"I do not think it possible for the Forest Department to go too far in the matter of excluding goats from forests in India. The grazing of sheep may in certain cases and within certain limits be allowed without much risk of damage, but goats should in all cases be strictly prohibited. Often when I was in charge of the Sholapur Division have I come across cases where goats trespassing in the Kurans which are under reboisement have cropped the seedlings short. The goat has a special liking for a succulent young babul, though he does not disdain the leaves of the old tree either, but, standing on his hind legs, can crop the leaves and twigs to a considerable distance above the ground. Sheep do less harm, as they are content with the grass, though the young babul seedlings coming up with the grass suffer from their browsing.

"Similarly in wooded districts where the forests are regenerated by seedlings and coppice shoots, the young trees have no chance if goats are allowed in the forests, but are either browsed down and killed or survive to grow up into stunted misshapen trees. Young seedlings and sprouts that escape their voracious maws fall victims to their sharp split hoofs. The soil also is loosened and rendered friable, so that, if on slopes, it gets washed down when the rain falls, and the rocky subsoil being laid bare reproduction becomes a matter of difficulty. Such cases have come under my notice quite recently in this district."

The Divisional Forest Officer, Khandesh, Mr. R. S. Fagan, reports:—

"I have seen myself both in the Nagar and Sholapur districts sheep that are taken to pasture without goats. In Khandesh the Tilaris, who are the chief sheep-farmers, persist that sheep cannot graze without goats. I think that this opinion has been formed owing to two causes: first, the conditions of the forests (for that is where the largest 'rain pasture' lands of the zilla lie) were all up to a very late date, and even now are, largely constituted by heavy jungles. These lands are not as eminently suited for sheep pasture as for goats, owing to the sheep being a short-grass cropper, whilst the goat is pre-eminently a tree cropper. But sheep have a very facile habit of following any leader, and

take to tree-cropping when they see goats doing it and the grass too long for their mode of grazing. In Sholapur and Nagar, where the forests are principally grass lands, the people used, before goats and sheep were excluded, to graze their large cattle first and the sheep afterwards, and they gave it as their reason that sheep could not crop the long grass. When sheep were excluded from all but the free-grazing lands, after a year or so the people saw that their large cattle refused to graze in the free-grazing lands as freely as in those from which sheep were excluded, and there are petitions on record in the Nagar office asking for sheep to be excluded from free-grazing lands.

"The second reason on which they founded their opinion emanated from the first, for the goats acted as collies to their larger (in numbers) and more stupid companions, and saved the herdsmen a great deal of trouble in driving. It only requires a few more herdsmen and a little time for the sheep to get out of their habits and for them to be driven quite well enough for grazing purposes.

"If we allow goats with sheep, we turn the latter into as destructive an animal as the former to all our young growth, and this in our forests, constituted as they are by individuals of mixed ages, is simply fatal.

"I have seen so much of the damage done to young growth of our forests by goats and sheep, that it would be impossible to quote every case here. There is not a forest where goats and sheep have been allowed that has not its young seedlings more or less damaged, according to the number of animals and the area.

"There are the forests of Nandurbar, quite close to where I am now, in which the forest areas have not got the same amount of jungle on them that similarly constituted lands elsewhere have. How the jungles in the former were destroyed I cannot profess to state; probably they were cut down, but the growth, instead of improving under a conservancy which has existed for ten years, is going backwards. This is palpable to the most casual observer; every bush and shrub is in a deteriorating state. Trees there are none to speak of, and these bushes are one and all nibbled to the very stump. Next rains they will shoot out again to be nibbled back until they eventually succumb.

"I have seen the destruction caused by sheep and goats in Anjan forests. After a felling, if the re-shoots are nibbled, they seldom live more than two years, and I have satisfied myself that the Anjan, if left alone, can re-shoot very strongly. The areas of the Anjan fellings in Dhulia Range of past years were ruined as far as regeneration of that species was concerned, when the stools were cut level with the ground and the shoots came in reach of the goats and sheep.

"In babul forests, if sheep and goats are allowed in sufficient numbers, not a seedling will be found after they are gone. In fact, sheep

and goats are the curse of our forests, and destroy other far more important interests by their grazing, and they should never be allowed in any but purely pasture lands."

The Divisional Forest Officer, Nasik, Mr. W. G. Clabby, reports :—

"Constant complaints are received from the people of the Nandgaon, Baglon, and Malegaon talukas that, owing to the admission of sheep into their grazing lands used by villagers for cattle of the bovine species, their animals suffer, as the sheep are such close feeders that the larger animals cannot pick up anything.

"In the Nandgaon Range yearly large flocks of sheep are admitted into forests. The consequences of such a course are becoming more and more apparent every year: the ground is being cut up and laid bare, and the grass is to be seen sparsely scattered here and there; any young seedlings that may chance to show themselves are cut back closely to the ground or trampled down and torn out by the roots by the hundreds of sharp hoofs passing over the ground."

The Divisional Forest Officer, Ahmednagar, Mr. Horatio Mainwaring, reports :—

"The injurious effects sheep and goat grazing have on forest lands is well known to all who have anything to do with forestry. More especially does this apply to such lands as are undergoing re-forestation, such as most of the Deccan reserves on the hill slopes and plains.

"Concerning the evil of goats, there can, I take it, be no doubt whatever; one has only to watch the animals feeding to see that he takes up all forest vegetation that comes in his way, even standing on his hind legs to get at the leaves and tender upper branches.

"Concerning the grazing of sheep there is more room for doubt. Where there is good grass to be had, I fancy sheep prefer such to feeding on leaves; where the grass is scanty and poor in quality (as in most of the mâl lands and hill slopes of the Deccan reserves) sheep do not object to satisfying themselves by eating leaves and succulent young seedling. But it is not alone by their feeding proclivities that most damage is done by these animals in the way of hindering re-forestation. It is by the trampling of their sharp-pointed hoofs when driven in herds and flocks over the forest reserves that the chief injury is done. Seedlings which have successfully battled against the drought and heat of the Indian summer receive their quietus from these pests to forestry.

"One has only to look at the side of a hill over which these animals have been driven and note the ridges of dust or clay (according to the state of the weather) which run parallel to the sides of the hill slopes formed by processions of these animals when feeding, to see how futile it is to expect any forest vegetation having a chance of making headway against such drawbacks.

"People might, and do, say—'But many of your reserves are simply grass lands without any forest vegetation whatever. What harm can sheep and goat grazing do on such lands?' To such queries I would reply—many of such lands have only lately come into our possession; to admit sheep and goats on such lands would be to take away the last chance that there is of creating forest vegetation on them. Of course in some cases it may be imperative to admit these animals on forest lands should the grazing elsewhere be insufficient. In that case I would allow them on the mâl lands of the plains *only*, and on no consideration on the hill slopes.

"The Conservator will remember the protest of the villagers of Wari, taluka Kopergaon, against admitting sheep and goats in their grazing land."

The Divisional Forest Officer, Poona, Mr. Wroughton, states :—

"As to facts which have come under my personal observation, I can only say that, were I to record a tittle of the cases which I have seen, I could fill sheets: from the bare moor on the Blair Athol Estate in Scotland, which I saw transformed into a thicket of Scotch fir by the exclusion of sheep and deer in 1869, to the hillside on which a felling had taken place last year and the coppice shoots had been so cleanly eaten down by sheep and goats that not a leaf was to be seen, which I saw only the other day in an inam village near Bhatghar. Almost any gairan in the Sirur Range of this Division would furnish ample evidence of the result of sheep and goat-grazing.

The Divisional Forest Officer, Working-Plans, Mr. T. B. Fry, reports :—

"I have sometimes found the stems of babul seedlings stripped of leaves and the upper part crushed into the shape of a native tooth-brush. In such cases the plant has but little chance of surviving through the hot weather, or at the best it will become a misshapen tree.

"In part of Sangola especially the difference is most noticeable between those hill slopes which have been closed against sheep and similar lands where they have been permitted to graze. On the former there is a strong young ligneous growth of various kinds, partly natural and partly due to broadcast sowings; whereas on the latter, although the soil is precisely similar and broad-casting has been done, scarcely any forest growth can be seen except a few bushes hopelessly stunted.

"In Sangola again there are one or two private forests of considerable extent into which sheep and goats are never admitted, although horned cattle are allowed to graze on payment of fees—a clear proof that the destructive nature of sheep-browsing is fully understood by intelligent natives."

Mr. Gleadow, the Divisional Forest Officer of Surat, says :—

"For the last ten years it has been my business and pleasure to keep a sharp look-out for young seedlings, and the result of this experience is clearly and decidedly that in areas freely grazed by goats and sheep it is useless looking for them. The occasional plant that survives is an eyesore, a leper among trees, a deformity to shudder at, unfit either to live or to continue its species."

The Divisional Forest Officer, Panch Mahals, Mr. H. W. Keyes, has written as under :—

"In poor, open forests, such as those of the Panch Mahals, *any* grazing is hurtful; but the grazing of sheep and goats in such lands is fatal to any improvement of the forest growth, by which I do not mean that a teak tree 20 years old will not grow on for another 20 years whether the forest at its base be grazed or not (it may seem superfluous to note this, but it is an undoubted fact that many Revenue Officers are unable to imagine how grazing can hurt forests which consist of trees), but that seedlings have no chance of surviving where the forest is open to the depredations of sheep and goats. Sheep, as is well known, browse down everything on the surface of the ground until the soil is absolutely bare, while goats are even more destructive with their irrepressible taste for young and tender shoots of all kinds. I have seen goats reaching up to devour twigs at a height of fully 6 feet from the ground. As these animals prefer the young leaves and shoots, it is the custom too, in the Panch Mahals at any rate, for the goat-herd to carry a long pole with a knife attached at the upper end with which to behead young saplings and lop off new shoots of all kinds in order to strew the ground with fodder for their herds."

Colonel McRae, Conservator of Sind, says :—

"I can say from much experience that without rigorous exclusion of goats and sheep from areas under reproduction, where the principal growth is of species of trees that goats and sheep can eat, enclosures are mere waste of money and trouble. The forests under my own charge are divided into compartments of 160 acres each; these are worked in succession and closed for reproduction.

"Horned cattle can often be admitted as early as six months after closure, but goats have to be excluded for four or five years, and sheep nearly as long.

"Sheep in this province do not require goats to lead them, though very often there are goats kept with flocks of sheep, but these are for the convenience of the owner and not kept as a necessity.

"If denuded lands have to be re-clothed, the exclusion of goats and sheep is an absolute necessity, as the forest growth that begins to show on such land in the Bombay Presidency is often, if not invariably, species of Acacia and Prosopis, and these the goats and sheep would eat up as fast as they appeared.

"I can show thousands of acres in my own forests that have become covered with dense jungle from the simple process of excluding goats and sheep, and for the first year or two horned cattle also, whereas similar and adjoining lands outside forest limits are bare of trees. In our ordinary working, if a compartment is not closed after it has been cleared, or if the closure is imperfectly maintained by the carelessness of the Forest guards, the fresh growth is ruined by goats. Sheep do not do so much damage as goats, but they do a great deal, as they eat up seedlings and fresh coppice-shoots of all edible kinds of trees; but after the seedlings and coppice-shoots have attained the height of two or three feet, sheep do very little damage, as they do not bend down a young tree to get at the upper branches."

Mr. Peet, Conservator of the Northern Circle, *Madras Presidency*, communicates the following notes:—

"From Ganjam, the Collector, Mr. J. G. Horsfall, kindly sends the results of his experience in the Kistna district. He remarks that in the latter district he tried the experiment of excluding goats and sheep from the Bezwada hills, which were nearly bare. For the first three years there was little or no result; but the fourth year there was a most marked difference between the conserved and unreserved hills, and this too by nature unassisted.

"Mr. Horsfall adds: 'I regret I cannot state whether the improvement has continued, as it is five years since I left the district, and my successors may not have continued the experiment.'

"From Godaveri, Mr. Battie, the District Forest Officer, notes the fact that in the plains forests proper reproduction is found only in the tracts remote from villages; and in the vicinity of some villages, especially of those abounding in goats, there is no herbage over an inch high. He draws attention to an article in the June *Forester*.

"From Kistna, Mr. Homfray, the District Forest Officer, states that the long-legged variety of goat is most destructive to trees. In fact, his experience is that it never eats the jungle grass at all, but subsists entirely on the leaves of trees. Of these, the goats eat the leaves of almost every kind, but chiefly of some kinds which are important to the district—namely, *Hardwickia binata*, *Albizzia amara*, and *Acacia ferruginea*. There is throughout the forest an almost entire absence of seedlings, which is not due to fire, but to excessive grazing, and chiefly to the damage done by goats. In Mr. Homfray's opinion cattle and sheep do very little damage. The *Hardwickia binata* seeds profusely during the rainy season and seedlings come up, but they are eaten off annually by goats The evil does not stop here. It has been the immemorial practice of the shepherds to lop the branches of trees, *Hardwickia* especially, which have grown up too high for goats to reach.

"Efforts have been made to counteract this evil, but have met with little success, as goats are taken to the forest solely for the purpose of feeding them on the leaves of trees. Over 50,000 acres of land, where *Hardwickia* preponderates, there is hardly a tree to be found which has not been pollarded. This tract would have been very valuable, as *Hardwickia* in that district is as valuable as teak; but, thanks chiefly to the evil done by goats and goat-herds, there is hardly a good timber tree to be found in the forests now taken up for reservation. It does not do to overstate a case, for part of the damage done in pollarding *Hardwickia* is probably for the sake of the fibre from the young sprouts; but as Kistna is pre-eminently a grazing district, I have no doubt that Mr. Homfray's account is true that excessive damage is done by goat-herds.

"Sheep are allowed in all forests which are open to grazing, but few are taken to the forests, as they are generally pastured in the fallows and waste-lands adjoining villages. Mr. Homfray thinks, but is not sure, that the damage done by sheep varies according to their variety, and that the woolly variety feeds chiefly on grass and is comparatively harmless, whereas the hairy goat-like animal certainly browses on trees and shrubs, but probably not by preference, but on account of the scarcity of grass.

"From Nellore the District Forest Officer, Mr. Brougham, remarks that it was notorious in his former district, Bellary, that the growth around villages was less favourable in proportion as more goats were kept; and in Nellore he notes that in the low land jungles trees are reduced to the form of stunted scrub chiefly from the ravages of goats.

"From Cuddapah the District Forest Officer, Mr. Lodge, writes that he has seen what ought to have been fine young trees develop into stunted shrubs owing to every shoot being nipped off by goats; and he believes that no timber trees can be grown if goats are admitted before the heads of the trees are beyond the reach of goats. He remarks that in Cuddapah there is no forest in the condition of pure high forest, and that he has not noticed any damage done by goats to trees the heads of which are beyond their reach, probably because there is enough undergrowth to prevent any tendency to injuring the bark. However, goat-herds are here also noted as very mischievous, and Mr. Lodge has seen a splendid 'gaulis' of satin-wood *(Chloroxylon Swietenia)* utterly destroyed by them in the Kottakota reserve in the Anantapur district. Sheep do little or no damage in his opinion, and it is not considered necessary or even useful to put a few goats in each flock.

"Mr. Ward, Sub-Assistant Conservator, states that from his observations in Cuddapah goats make by preference for the terminal shoots of young trees, standing on their hind legs for the purpose.

"He remarks that the ryots are themselves so convinced of the dam-

age done by goats that the closing of the forest against them is the only rule to which they have submitted without a murmur. Regarding sheep he has not noticed much damage done by them, as they are generally pastured near villages.

"My own observations are chiefly confined to the Wynaad and the Madura and Coimbatore districts. In the former, the vegetation is so luxuriant that it would seem in many parts almost impossible to retard its growth; but I have known a moderate flock of goats kept for some years on the same ground make a most perceptible difference on the adjoining patch of forest, destroying all young growth and keeping some trees in a constantly stunted condition. In Coimbatore one of the best instances I know of the effect of goats on vegetation is seen on a hill known as Ayasawmy Hill, within sight of Coimbatore town. The natives whom I questioned stated that it once had water on it and a fair growth of forest like the hills in the neighbourhood. Now there is no water at all during the greater part of the year, and the vegetation is kept down to the condition of the veriest scrub, for goats are still grazed over it, being the only animals apparently which can stand the absence of water and the poorness of the vegetation. Gradual destruction of the growth is attributed by the natives themselves to the goats. The effect of goats, however, is visible all over the district by the stunted character of the growth where they are kept in great numbers, and reproduction is impossible where large flocks are admitted into the forests.

"In some parts of the Madura district I have noticed all the growth in the plains almost disappear and the scrub on the hills regularly stunted by goats; and the same effect was noted by me in the Erode taluk of Coimbatore on some low-lying hills, and also the counter-effect of the exclusion of goats by natural agency. On some of these hills goats were kept away from seedlings by a growth of prickly-pear, and the hill in a few years showed quite a promising growth of young trees. I can add to the testimony of the mischief by goat-herds. My own observation leads me to conclude that goats always prefer the leaves of trees to grass, but that sheep almost always prefer grass to the leaves of trees; but I have known the latter very destructive in times of scarcity."

Mr. Cherry, Conservator of the Southern Circle, *Madras Presidency*, writes as follows:—

"On the 'jardinage' system of working, the admission of goats is incompatible with Forest conservancy. As one Forest Officer observes, this is so far a truism that it admits of no argument, and, as another shows, the destructive propensities of the goat are such as to have given rise to the Tamil proverb, 'Goats spoil a jungle just as a wandering king a country.'

"In common with the other Forest Officers, both Colonel Walker (my

predecessor of 24 years' service and myself with 19 years' service) are agreed that ordinarily it would be impossible to secure reproduction—either natural or artificial—if goats were admitted. We can testify to the havoc done by goats in all these southern districts, and to the very marked improvement noticeable even after the short period of their exclusion.

"In this Circle, the first step has been to exclude goats as soon as a reserve has been defined and declared, and so readily do the natives see the necessity of this, that it is seldom they seriously complain against it, though they are eager enough to push their claims in regard to their sheep and cattle.

"We have not been so ready to exclude sheep, partly because they are not nearly so mischievous as goats, and partly because it has been inexpedient (as it has been also with the cattle) to interfere too abruptly with their hitherto unrestricted grazing.

"As regards injury to forest growth by sheep, I must make a distinction between the long-legged sheep, which is almost a goat in habits and tastes, and the short-legged sheep, which only browses when there is no grazing.

"There might be circumstances when the voraciousness of the goat could be turned to some use in getting rid of weeds and noxious undergrowth, but it would only be in such forests, or parts of forests, in which a sufficiency of young growth had outgrown the possibility of damage, and in which no cuttings had been planted for some time to come. The difficulty, as pointed out by you, would be to confine the animals to those particular areas."

Mr. Wooldridge, Deputy Conservator of South Arcot, writes :—

"*Sheep-grazing.*—The long-legged, short-coated, brown variety, known as 'Shemble Adu' in Tamil, damage re-growth of timber, &c., stock by browsing on certain kinds of saplings and useful plants, especially when pasturage in the shape of suitable grasses is scanty. I have not observed that any stem-bark is chipped off by this variety of sheep, but they will greedily nip off young seedlings among the grass or elsewhere without selection, and do a greater proportion of damage to the young stock in 'coppice' and on 'selection fellings.'

"The black or brown-faced, long-woolled, usually white (but sometimes wholly black) variety, known as 'Kurumba Adu' in Tamil, does far less damage to seedlings than the former; they are more truly graminivorous, and may be said to usually do little harm to re-growth by seedlings in any low country forest or compartment in which there may be pasturage available for them.

"*Goats.*—Goats are destructive to seedlings of any variety of tree or shrub, usually until the sapling is strong enough to withstand the weight and force of an old goat climbing on to it either from a rock, some

other tree, or from the ground; in this plan of reaching the leaders of an otherwise well-grown sapling, the animals get very expert, and as the country goat grows to 25 inches and up to 30 inches at the shoulder and proportionately heavy, having a stretch of about 6 feet from hind to fore feet when extended upon a sapling, a forest compartment treated for timber growth would not be safe from injury until the saplings of even the quickest-growing trees, and under most favourable conditions of growth, were over five years old: further, as most of the deciduous forests have been worked by the selection method, 'goat-grazing' unrestricted must do an immense amount of harm to the re-growth in all these forests: goats will also, like deer, nibble at the stem-bark of saplings."

Mr. Stanbrough, Deputy Conservator of Trichinopoly, records the following note:—

"It is a fact that goat-herds seldom graze their flocks without the bill-hook to chop fodder.

"2. The goats treading on the soil so harden it as to make natural reproduction an impossibility. In these parts, the threshing-floor is generally prepared by making the goats walk over it for a few hours. The floor thus prepared becomes harder than a metalled road.

"3. I can in this district point out many tank beds of *Acacia arabica* and *leucophlæa* resorted to by goats and also similar ones in charge of the Department where these animals were strictly prohibited. The growth in the former is nothing but stunted and dwarf shrubs with no advance growth to speak of, whereas in the latter they flourish, and, wherever there is open cover, plenty of seedlings can be observed."

Mr. Morgan, Deputy Conservator of North Malabar, says:—

"When I was in charge of the North Coimbatore district, from 1874 to 1878, goat and sheep-breeding was extensively carried on along the bases of the Nilgiri and Burghoor hills, and the range of hills from near Pothanore to Palghat. The effects of unrestricted grazing were as follows:—

"Most of the larger-sized trees were constantly pollarded by the goat-herds for the animals to feed on, and thus rendered worthless as timber;

"All young saplings were continually nibbled down till they became bushes, throwing out numbers of side shoots in consequence of the leaders being so frequently destroyed.

"On the range of hills last mentioned (which are very rocky) the forest had almost altogether disappeared, and given place to a scrubby growth of bushes.

"On areas ravaged by goats, where protection was introduced, the subsequent growth was wretched; saplings that had been converted into bushes by the goats shooting up with several stems and the pollards

growing into unsightly trees only fit for fuel. Of course this could have been remedied by a subsequent clean cut, when good straight coppice-shoots would doubtless have been produced.

"The damage done by sheep is infinitesimal compared with that of goats.

"Natives in Southern India prefer goat's flesh to mutton, and the goat is by them considered a far more hardy and profitable animal to keep than sheep.

"The skin of an adult goat is worth from Re. 1 to Re. 1-12, whereas a sheep-skin is only valued at from 2 to 4 annas.

"On the Nilgiris there are thousands of acres of Badaga land peculiarly adapted for goat-breeding. This land is covered with low scrub, and there are no trees of any value. There are numerous rocky and precipitous hills which the goats delight in. In such localities goats are an advantage and the harm they do is reduced to a minimum, more than counterbalanced by the profit derived from their keep."

In European and other countries there are numerous historic instances of forests having been annihilated by unrestricted grazing. According to Beatson's "Saint Helena," introductory chapter, and Darwin's "Journal of Researches in Geology and Natural History," pages 582 and 583, it was the goats which destroyed the beautiful forests that, 350 years ago, covered a continuous surface of not less than 2,000 acres in the interior of the island [of St. Helena], not to mention scattered groups of trees. Darwin observes * :—

"During our stay at Valparaiso, I was most positively assured that sandal-wood formerly grew in abundance on the island of Juan Fernandez, but that this tree had now become entirely extinct there, having been extirpated by the goats which early navigators had introduced. The neighbouring islands, to which goats have not been carried, still abound in sandal-wood."

The political decadence of Spain has been distinctly traced to the destruction of the forests † :—

"Spain seemed destined, by her position, to hold dominion over the world, and this in fact she once possessed. But she lost her political ascendancy because, during the feeble administration of the successors of Philip II., her exhausted treasury could not furnish means of creating new fleets, the destruction of the woods having raised the price of timber above the means of the State."

But historical evidence is still more conclusive regarding the

* Marsh: "The Earth as modified by Human Action," page 383.

† Ibid., page 306.

destructive changes which have been occasioned on the Alps, the Apennines, the Pyrenees, and other mountain ranges in Central and Southern Europe. "In some localities the progress of deterioration has been so rapid that a single generation has witnessed the beginning and the end." * In a memoir quoted by Marsh describing the awful scenes of desolation brought about in the French Alps by the abuse of pasturage and the felling of the woods, it is stated that "the mountains seem to have burst forth in eruption to cover the plains with their ruins," and that "many villages are so destitute of wood that they are reduced to the necessity of baking their bread with sun-dried cow-dung, and even this they can afford to do but once a year." Marsh adds † :—"It deserves to be specially noted that the district here referred to, though now among the most hopeless waste in France, was very productive down to so late a period as the commencement of the French Revolution. Arthur Young, writing in 1789, says—'About Barcelonette and in the highest part of the mountains, *the hill pastures feed a million of sheep besides large herds of other cattle.* With such a soil and such a climate we are not to suppose a country barren because it is mountainous. The valleys I have visited are beautiful.'" Darwin, in his "Origin of Species," says:—

"But how important an element enclosure is I plainly saw near Farnham, in Surrey. Here there are extensive heaths, with a few clumps of old Scotch firs on the distant hill-tops. Within the last ten years large spaces have been enclosed, and self-sown firs are now springing up in multitudes, so close together that all cannot live. When I ascertained that these young trees had not been sown or planted, I was so much surprised at their numbers that I went to several points of view whence I could examine hundreds of acres of the unenclosed heath, and literally I could not see a single Scotch fir, except the old-planted clumps. But on looking closely between the stems of the heath, I found a multitude of seedlings and little trees which had been perpetually browsed down by the cattle. In one square yard, at a point some hundred yards distant from one of the old clumps, I counted 32 little trees; and one of them, with 26 rings of growth, had during many years tried to raise its head above the stems of the heath, and had failed. No wonder that, as soon as the land was enclosed, it became thickly clothed with vigorously growing young firs. Yet the heath was so extremely barren and so extensive that no one would ever have imagined that cattle would have so closely and effectually searched it for

* Marsh: "The Earth as modified by Human Action," page 246.

† Ibid., page 251.

food. Here we see that cattle absolutely determine the existence of the Scotch fir."

Again, in a paper on the Island of Cyprus, published in the *Revue des Eaux et Forêts* for February 1874, it is stated :—

"*It is not the axe so much that I accuse of having destroyed the forests of Cyprus as the goat.* It is for this animal that the shepherd kindles the great conflagrations, which pick out above all for destruction those forests which are highest and thickest and contain the most fertile soil, which he wishes to convert into grazing land. The goat browses down young reproduction, and leaves in its place endless thickets of Cistus, Arbutus, and Broom, or rocky exposed ground."

In an article reproduced in the *Indian Forester* for July 1884 it is said :—

"It has been stated—and we see no reason to doubt the statement—that the barrenness of Central Asia is due, in a great measure, to the destructiveness of the flocks and herds of the nomadic tribes. A traveller visiting this part of the world says :—'It was in the Kizzilkoom desert that I first appreciated the enormous force of these scourges. Once, as evening fell, I met a flock of goats advancing across the wilderness in a compact mass, one of whose points was occupied by the leading animal. The dimensions of this moving mass I judged to be about 150 yards long by 100 broad, and its area would, therefore, have been 7,500 square yards, and allowing two animals per square yard, there were 15,000 goats in the flock! During the whole of the day these animals had been scouring the adjacent country for miles in search of food, and every young shoot of vegetation they found must have been destroyed! Under such circumstances, is it any wonder that no water is to be met with, and that nature presents such unchangeable and persistently repellent aspects for mankind in regions where the youth of our race was passed?'"

As regards the management of forest-grazing in other countries, in a most interesting and instructive Note on the subject drawn up by Monsieur Puton, the Director of the French Forest School, assisted by Professors Boppe and Guyot, it is stated :—

"Whatever may be the circumstances which render it necessary to admit cattle into a forest, the grazing should be subjected to the following restrictions :—

"(1). Under no circumstances should goats and sheep be allowed into any forest which it is possible to place under regular forest treatment.

"(2). Each herd or flock should be in the charge of a shepherd, who would be responsible for any infringement of the grazing regulations and for any injury done by the animals in his charge.

"(3). All portions of the forest under reproduction, or containing very young growth, should be entirely closed to grazing.

"(4). In the hills, the upper strip of forest bordering on the pasture land should be closed to all grazing.

"(5). The number of animals allowed to graze should be proportionate to the area available.

"(6). No animal should be allowed into the forest before the season at which the young crop of grass for the year appears.

"As regards the absolute exclusion of goats and sheep, it is not meant by this that sheep must necessarily be excluded from all wooded areas. This is not always possible or advisable; but that wooded areas in which these animals are allowed to graze cannot be subjected to any regular method of forest treatment. Any money spent on works of forest improvement in such areas will be useless and mere waste, and the best thing is to abandon the area in question as 'forest.'

"In the great forests not yet opened out in mountainous countries, the best thing to do is to mark out various heights, so that some areas may be accessible at all seasons, areas detached from the forests which should be given over exclusively for sheep and goat-grazing. These areas should be chosen in such places where their denudation will cause the least danger as regards the formation of torrents and so forth. Horned cattle could be admitted into the other areas subjected to regular forest management; but all goats and sheep would be rigorously confined to the areas specially set apart for them."

As regards *legal restrictions* on grazing in France, the browsing of goats in the State reserves is absolutely prohibited by law. It is considered that the introduction of these animals into a forest is incompatible with the maintenance of the ground under a crop of trees.

The regulations regarding grazing are contained in the Forest Code of 1827. But these laws date from the most distant times. In 1541, Francis I. revived the decrees on this subject, which were then in existence, and these were again sanctioned in 1660 in the celebrated Forest Ordinance by Colbert. The existing Forest Regulation on the subject is merely a repetition of these ancient laws. Monsieur Puton writes :—

"The principal measure contained in the old laws consisted in the power to close to all grazing for a definite period certain portions of a forest which appeared to require it, or even the entire area if this appeared necessary for the safety of the forest. Under the existing law, instead of *closing* certain specified areas, the areas *open to grazing*, in which the right-holders are to be allowed to graze, are fixed each year by the Forest officers (Articles 67 and 69), as also are the roads and paths

(Article 71) by which the animals grazed are to be allowed to pass through the closed portion of the forest on their way to the open portions, the number and kind of animals which the right-holders are to be permitted to graze, and the time during which they can be grazed. *The introduction of goats is absolutely prohibited, non-obstant tous titres ou possessions contraires*—Article 78. The same restriction is placed on sheep; but, in cases where there are no other means of providing for their support, the Chief of the State may permit the cultivators living on the borders of the forest to graze their animals in the portions of the forest open to grazing.

"As regards animals other than sheep and goats, the Forest officers fix the number that may be grazed each year and the period during which they may be grazed. This number is necessarily proportionate to the area thrown open to grazing each year (Article 68, of Articles 65 and 66).

"Finally, right-holders are only allowed to graze animals required for their *bonâ fide* domestic purposes (Article 70). They are not allowed to graze animals kept for trade or speculation.

"In order that the Forest guards and Inspectors may recognise the animals entitled to graze in the forests, these are branded (Articles 73 and 74), and the larger cattle carry a bell in addition.

"Finally, the animals are all grazed together under one shepherd. In this the modern law has entirely followed the ancient regulations, as it was found that with a number of animals scattered through the forest, supervision became impossible. Each village 'commune' or group of right-holders is, therefore, obliged to unite the cattle under the authority of one or several shepherds appointed by the commune (Article 72). Groups of right-holders are not, however, allowed to unite their flocks under one shepherd, as too great a number of animals together injure the soil.

"The shepherds appointed are directly responsible for breaches of the regulations or injuries done by the animals in their charge, and, if fined, the commune appointing them are responsible for the payment of the fines (former Article 72).

"There are very severe penalties for a breach of any of these grazing rules. Right-holders introducing goats or sheep are subjected to a double fine. Right-holders who introduce more animals than they are entitled to, or who graze on closed portions of the forest, are treated as if they had no rights and subjected to the same penalties as if they were outsiders.

"The essential rules, which would probably also be applicable to forests in India, are—the absolute exclusion of goats, the opening of definite portions of a forest for a definite term only, and the closing to grazing of all the rest, and making duly-appointed shepherds responsible

in common with the right-holders for injuries done to the forests by the animals in their charge. But these restrictive measures should be introduced gradually. Their introduction is a question of time and *tact*. But the drier and hotter the climate, the greater the severity necessary.

"In addition to these measures, efforts should be made to bring about the gradual abandonment of grazing in the forest by the neighbouring population. The first step is the development of agriculture. When cultivators recognise that it is in their own interest to keep their animals at home and thereby obtain manure for their land, they will soon adopt the course. Fifty years ago the forests in the Vosges were overrun with cattle. At present no animals are grazed in the forests and the cultivators refuse to send them there.

"The second measure consists in developing the value of the forest produce by means of roads and of manufactories which utilise these products. People respect property of real value. It has been said that the chief reasons why the forests in the mountains of Auvergne and the Alps were destroyed by excessive grazing were because the wood was without value in such out-of-the-way places, while forests round Paris have been preserved because there was always a good market for their products.

"In such matters it is well to take into account the situation, and to be the more severe in those places where grazing does the most harm, such as in dry hot climates."

In a note published in the *Indian Forester* for June 1885, Colonel Bailey, Conservator of Forests, writes as follows regarding the provisions of the French Forest Code on the subject of grazing :—

"Article 63 provides that the Government can free a forest of all rights *in wood* by surrendering entire possession of a portion of the area to the right-holders. Article 64 goes on to say that other rights of user, including grazing rights, cannot be commuted in this manner, but that they can be bought out by means of compensation fixed by mutual agreement, or in case of dispute by the Courts.

"Nevertheless, the commutation cannot be insisted on by the Forest Department in places where the exercise of the right of grazing has become an absolute necessity for one or more *communes*. If this necessity is disputed by the Department, the parties must go before the *Conseil de Préfecteur*, which, after an enquiry *de commodo et incommodo*, will decide, subject to an appeal to the *Conseil d'Etat*.

"Here it should at once be explained the right of grazing sheep and goats is not included in the above provisions, for Article 78 stands thus—

"All right-holders are forbidden, in spite of rights and actual enjoyments of the practice to the contrary, to drive or cause to be driven goats or sheep into the forests or unwooded tracts belonging to the forests

under penalty, against the owners, of a fine double of that fixed by Article 199, and against the herdsmen or shepherds of a fine of 15 francs. In case of repetition the herdsman will be sentenced, besides the fine, to an imprisonment of from five to fifteen days. Persons who claim to have enjoyed the above right of sheep-grazing in virtue of valid written titles, or of a prescriptive right equivalent to the same, can, if their claim is admitted, obtain compensation, the amount of which will be settled by mutual consent, or, in case of dispute, by the Courts.

"'The grazing of sheep can nevertheless be authorized, in certain localities, by Royal ordinance.'

"Goats* are not admitted into any forest which is under the *régime forestier*, as the grazing of these animals is considered incompatible with the maintenance of the ground under wood. The old laws suppressed without compensation to the right-holder, the grazing of sheep in the forests of the ancient royal domains of France, and the law of 1827 (above quoted), suppressed it also, but on payment of compensation, in those State forests which are of more recent origin. The law also prohibits, as a general rule, the grazing in the Communal forests of both goats and sheep belonging to the inhabitants of the Communes. But the Government has the power to permit sheep-grazing both in the State and in the Communal forests in certain localities, and as an exceptional and temporary measure. Permission to drive sheep into the State forests is very rarely accorded, but it is not yet found possible to suppress the practice in the Communal forests, and sanction to graze sheep in them for periods of from one to five years is still granted to the inhabitants in a considerable number of cases.

"To return to Article 64. When money compensation is awarded in lieu of grazing rights, it is paid on the marked cattle, and there is therefore no difficulty in knowing to whom the money is to go; but nevertheless there are manifest objections to this method of disposing of the right, and the author of an article in the *Revue des Eaux et Forêts*, 1881, page 183, remarks that it is matter of regret that the law sanctions the exchange of a real servitude, belonging to the communes, for a sum of money, as this is to permit the present generation to dissipate the value of a patrimony as useful to future generations as it has been to those which are passed. Probably the best plan, in case it is absolutely necessary to get rid of the cattle, is to provide them with grazing grounds elsewhere, taking up land and converting it into good pasture where this is necessary; and this appears to be the only possible course in cases where it is decided that the right of grazing is an 'absolute necessity' for the people.

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* The epithets which Manwood's Chief Justice seems to have applied to these animals have very properly been suppressed at page 135 of Baden-Powell's Manual of Jurisprudence!

"Article 65 of the Code lays down that in State forests which are not freed of grazing rights by the payment of compensation, the exercise of the right of user can always be reduced by the Forest Department in proportion to the condition and *possibilité* of the forest, and that it cannot be exercised at all except in conformity with the regulations contained in the subsequent Articles. It is further stated that in case of dispute regarding the *possibilité* and condition of the forests appeal can be made to the *Conseil de Préfecteur*. By *possibilité* in this case is meant *possibilité* in grass,—that is to say, that cattle must not be admitted in excess of the number for which there is a supply of grass and the ground must not be overgrazed; the grass roots being pulled up and the soil trampled down so that the supply of fodder in future years is diminished. M. Briot says that all ruminants ought to get about 3·3 lbs. of dry grass daily for every 100 lbs. of their weight; but he also remarks on the obvious difficulty that exists in the determination of what the actual *possibilité* in grass of any forest really is. In practice it is not usual to make any calculation of this sort, but the effect of the grazing is carefully watched, and if it is thought that the number of cattle is too large, measures are taken to reduce it. The number must evidently in such a case be reduced somehow or other, not in the interest of the Forest Department, but in that of the people themselves, for if the ground is overgrazed, the production of grass is at any rate temporarily diminished; but the Forest Department also profits indirectly, for if the number of cattle is excessive and the supply of the food they prefer is insufficient for them, they are compelled to browse on the young trees, and thus to damage the forest seriously. All endeavours to reduce the numbers of cattle are, however, usually hotly disputed. As to whether the Forest Department has a right to improve the condition of the forest to the impoverishment of the grass, the law is silent on this subject; but it is certain that grazing can be prohibited to the extent necessary in order to maintain the *status in quo*, whether by planting or sowing or otherwise. Unless, however, the demand on the forest in the matter of grass is less than the *possibilité* as above defined, so that the quantity available can be diminished without a corresponding reduction in the number of cattle to be admitted, the improvement of the crop of trees in such a manner as materially to reduce the grass supply would at any rate be very strongly opposed by the right-holders; and in this event it would be desirable, if possible, to do what has been above suggested in the case of forests which it may be wished to free entirely of grazing rights, *viz.*, to provide other grazing grounds to meet the deficiency caused by the improvements.

"It is provided by Article 119 of the general rules made under the Act that every year the local Forest officers shall establish by a *procés-verbal*, having due regard to the nature, age, and situation of the trees, the con-

dition of the blocks of forest under the *régime-forestier*, which can be made over for grazing; they are to indicate the number of animals that can be admitted to them, and the dates on which the exercise of the rights of user may commence and must end. The proposals of the Forest officers are to be submitted for the approval of the Conservator before the 1st February in each year.

"Article 67 of the Code lays down that whatever may be the age or the species of trees, the right-holders can only exercise their rights in the blocks declared out of danger by the Forest Department (subject to an appeal to the *Conseil de Préfecteur*), and this in spite of all actual enjoyments of the practice.

"Article 68 states that the Forest Department will fix, according to the rights of the right-holders, the number of head of cattle that can be admitted to graze. Who then are the right-holders?

"Article 61 provides for the extinction of all rights of user not formally recognised either at the date of the promulgation of the present law, or subsequently in consequence of claims made before the tribunals within two years of the date of its promulgation. Article 62 bars the accrual of fresh rights, and Article 218 lays down the manner in which claims were to be dealt with. At present, then, no persons who do not possess formal titles are acknowledged to have any rights. The persons who possess grazing rights are not all owners or occupiers of land, but may be artisans and others. They can of course only possess the right in respect of cattle which are their own *bonâ fide* property. The title rarely prescribes the number of cattle which its holder has the right to graze; sometimes it permits the exercise of right without payment, but sometimes fees have to be paid.

"Article 69 of the Code provides that every year before the 1st March the Forest officers shall communicate to the communes and private persons enjoying rights, the blocks which are declared out of danger and the number of head of cattle which can be admitted to graze, and the *Maires* are held responsible to publish the information in the communes referred to.

"Article 70 goes on to say that the right-holders can only enjoy pasture rights for cattle kept *for their own use*, and not for those which they buy in order to sell again, under penalty of a fine double of that prescribed by Article 199. The right then only extends to cattle kept for domestic or agricultural purposes, and does not extend to the animals of cattle-dealers or butchers.

"In order to enable the provisions of Articles 69 and 70 of the Code to be carried out, Article 118 of the General Rules lays down that before the 31st December in each year the *Maires* of communes and private persons enjoying the right of grazing cattle in the State Forests shall submit to the local Forest officer a statement of the number of head of

cattle which each right-holder possesses, distinguishing those which he keeps for his own use from those with which he trades.

"In Article 71 of the Code it is said that the roads by which the cattle must go, in order to pass to and from the pastures, will be pointed out by the Forest officers. If these roads traverse coppice or young high forest not out of danger, ditches sufficiently wide and deep, or any other kind of fence to prevent the cattle from getting in among the trees, can be made at the joint expense of the right-holders and the Forest Department and in the manner indicated by the Forest officers.

"Article 72 provides that the herd of each commune or section of a commune must be in charge of one or more common herdsmen chosen by the municipal authorities. As a consequence of this, it is said, the inhabitants of the right-holding communes can neither take charge of their cattle themselves nor send them to graze under a separate guard, under penalty of a fine of two francs per head of cattle. The cattle of each commune or section of a commune are to form a distinct herd unmixed with those of another commune or section, under penalty of a fine of from 5 to 10 francs against the herdsman, and of imprisonment for from 5 to 10 days in case of a repetition of the offence. The communes and sections are held responsible in respect of the sentences involving payment of money which may be pronounced against the herdsmen or guardians of the cattle, as well for the offences treated of in the chapter relating to State forests, as for other forest offences committed by them during the time of their service, and within the limits of the grazing ground. By Articles 73 and 74 of the Code it is provided that the cattle must all be marked with a special mark (it is usually applied to the skin, but sometimes to the horn); the mark must be different for each commune or section, and for every head of cattle not so marked a fine of 3 francs is exacted. The right-holder is held responsible to deposit the impression of his mark at the Recorder's office of the Court of First Instance, and the marking-iron itself at the office of the local Forest Officer, under penalty of a fine of 50 francs. The deposit of the impression and of the iron must be effected before the time fixed for the opening of the grazing (Rule No. 121).

"Article 75 of the Code provides that the right-holders must put bells on the necks of all animals admitted to graze under penalty of a fine of two francs for each animal found in the forest without a bell.

"Article 76 lays down that when the cattle of right-holders are found outside the blocks declared out of danger from grazing, or off the roads appointed to reach them by, the herdsman may be fined from 3 to 30 francs, and in case of a repetition of the offence he may be sentenced in addition to imprisonment for from 5 to 15 days.

"Under the provisions of Article 77, if the right-holders introduce into the forests a greater number of cattle than that which has been fixed by

the Forest Department in conformity with Article 68, they are liable, for the number in excess, to the penalties pronounced in Article 199.

"Regarding stray animals generally, Article 147 provides that persons whose conveyance, cattle, beasts of burden, or beasts for riding, are found in the forests off the ordinary roads or paths, will be sentenced as follows, *viz.*:—For each conveyance, to a fine of 10 francs in case the wood is 10 years old and over, and of 20 francs in case the wood is below that age. For each head of cattle not harnessed in carriages, to the fines fixed by Article 199, and this without prejudice to liability for damages.

"The last-named Article is as follows :—

"'The proprietors of animals found by day, unlawfully, in woods of 10 years old and over, will be sentenced to a fine of—

One franc for a pig.
Two francs for a sheep.
Three francs for a horse, pony, mule, donkey.
Four francs for a goat.
Five francs for an ox, cow, or calf.

"'The fine will be doubled if the wood is less than 10 years old; all without prejudice to damages, if any.'

"Under Article 201 of the Code the penalty is always doubled in case of a repetition of the offence (*i.e.*, repetition within a period of 12 months), and when the offences are committed by night. The *proprietors* are prosecuted under Article 199, and *in addition* the *herdsmen* are prosecuted under Article 76.

"As to the area of forest grazing required per head of cattle, this depends on the nature of the rock and soil, climate, slope of the ground, and other fixed elements, as well as on the quantity of grass available and the state of the young growth, which conditions vary from point to point and change from time to time. It is not possible at present to furnish any exact guide. A note by Mr. Brandis on this subject has appeared in one of last year's numbers of this journal, and M. Gazin says that in the Conservatorship of Chambery, Savoy, it is the rule to admit two head of large cattle per hectare (2·47 acres) from the 1st June to the 1st November between sunrise and sunset. This is in fir forests managed under the system of *jardinage*, and in blocks where felling operations have not been carried on for 10 years. It is said that the cattle do not eat the young fir trees. The figures given in the foot-note at page 133 of Mr. Baden-Powell's Manual relate to the *entire area* of France in the one case and of the Hautes Alpes in the other, and not, as might be supposed, to the forest area alone.

"M. Briot makes the following statement in the *Revue des Eaux et Forêts* of August 1883 :—

"'A word about forest grazing grounds. They are little valued. People would willingly do without them if they could, and even in the *Haute maur-*

ventue, where the best are found, *viz.*, those which shelter the larch forests, people use them very moderately. We have been told that in the neighbourhood of Mont Cenis, where the Forest Department opens the blocks which are out of danger, from the 15th May to the 1st November, they are hardly used before the 12th June; after some date between the 28th June to the 4th July, the cattle abandon them to disperse themselves over the mountains, except in the case of the highest compartments, in which the cattle of neighbouring pastures come to graze from time to time.'

"The people, then, do not require tree-shelter for their cattle, and from this point of view would like the whole country to be cleared of trees.

"Much might doubtless be done in India to diminish the necessity for grazing in the Government forests if more attention were paid to the condition of the grazing grounds outside them. At present there is no doubt that the village waste lands are not always cared for as they should be, and that frequently nothing is done to make the most of them. The French Law of 1882 relative to the restoration and preservation of mountainous tracts provides, among other things, for the regulation of the communal pastures.

"M. Briot has written a series of interesting articles in the *Revue des Eaux et Forêts*, 1880-81 and 1883-84, from which much can be learnt regarding the management of the communal grazing grounds in the French Alps. In his article of August 1883, pages 10-23, he gives the substance of various arrangements in force in Savoy.

"In this country, grazing is carried on in woods under the *régime forestier* after a declaration, by means of a *procés-verbal*, of the blocks which are out of danger. As the forests of the region are all *jardinées*, an extremely grave difficulty presents itself, namely, to find in these forests blocks which are really out of danger. The rule which governs the practice of grazing in the Conservatorship of Chambery is this: the block is supposed to be out of danger 10 years after cutting, and then two head of large cattle per *hectare* are admitted from the 1st June to the 1st November between sunrise and sunset. If the rotation be 12 years, then grazing can only go on in one-sixth of the forest at a time. In practice this system is adopted with great difficulty, and without stopping to consider the almost impossible task of controlling the number of cattle, which are not marked, or the manner of enjoyment of the right, which cannot be changed, and which proceeds from the nomadic life of the pastoral population during the summer, we will proceed to study the principal effects of grazing on the forest.

"The commune of Laus-le-Villard, Mont Cenis, gives to each owner of cattle a copy of the *Réglement rural*, of which the principal provisions are of the following nature, *viz.*:—The number of animals of each kind that can be grazed by each person is strictly limited; some of the animals are grazed free, and for others fixed dues are paid: the sheep of strangers

found grazing within the communal pastures are paid for: grazing in common by cattle and sheep having been found 'disastrous,' separate pastures are assigned for each class: the dates between which the various classes of pasture are opened are fixed, and the roads by which they are to be approached are indicated; lastly, the cutting or mowing of grass before the 15th September is prohibited, and even after that date it can only be cut in rocky ground, precipices, and other places which are inaccessible or dangerous for all kinds of animals. This latter provision is of course intended to permit the grass seeds to fall on the ground; there can be no doubt that precautions with this object are necessary, especially in dry regions, where the production is not vigorous, and that the cutting and burning of the grass before the fall of the seed should be strictly prohibited not less than once in three years.

"If some such measures as the above could be taken in India, the demand on the Government forests as grazing grounds might be much reduced."

JY. TIMBER MARKET.

STATEMENT OF AVERAGE SELLING RATES FOR TIMBER AND BAMBOOS FOR THE QUARTER ENDING 31ST MARCH, 1890.

AT MEERUT.

	RS.	A.	P.		RS.	A.	P.
Sál 10′ tors (poles), per score from	10	0	0	to	20	0	0
Sál karis, 12′ × 5″ × 4″ ,, ,,	25	0	0	,,	40	0	0
Sál bed-posts, 7′ × 2½″ × 2½″ ,, ,,	7	8	0	,,	12	10	0
Bamboos of 9′ to 10′, per 100 score, ,,	25	0	0	,,	80	0	0

AT CAWNPORE.

Sál 10′ tors (poles) per score from	6	0	0	to	7	0	0
Sain karis, 12′ × 5″ × 4″ ,, ,,	10	0	0	,,	12	0	0
Sál bed-posts, 7′ × 2½″ × 2½″ ,, ,,	3	0	0	,,	3	8	0
Bamboos of 9′ to 10′, per 100 score ,,	25	0	0	,,	40	0	0

AT BULANDSHAHR.

Sál 10′ tors (poles) per score from	0	0	0	to	0	0	0
Sál and sain, &c., karis, 12′ × 5″ × 4″, ,, ,,	0	0	0	,,	0	0	0
Sál bed-posts, 7′ × 2½″ × 2½″ ,, ,,	0	0	0	,,	0	0	0
Bamboos of 9′ to 10′, per 100 score ,,	70	0	0	,,	90	0	0

AT PILIBHIT.

Sál 10′ tors (poles), per score from	40	0	0	to	70	0	0
Sál karis, 12′ × 5″ × 4″ ,, ,,	30	0	0	,,	40	0	0
Sál bed-posts, 7′ × 2½″ × 2½″ ,, ,,	5	0	0	,,	6	4	0
Bamboos of 9′ to 10′, per 100 score ,,	60	0	0	,,	100	0	0

AT BAREILLY.

Sál 10′ tors (poles), per score from	5	0	0	to	10	0	0
Sál karis, 12′ × 5″ × 4″ ,, ,,	50	0	0	,,	60	0	0
Sain karis, 12′ × 5″ × 4″ ,, ,,	17	8	0	,,	25	0	0
Sál bed-posts, 7′ × 2½″ × 2½″ ,, ,,	6	4	0	,,	12	8	0
Bamboos of 9′ to 10′, per 100 score ,,	50	0	0	,,	137	8	0

AT MORADABAD.

Sál 10′ tors (poles), per score from	20	0	0	to	22	8	0
Sál and sain, &c., karis, 12′ × 5″ × 4″, ,, ,,	55	0	0	,,	60	0	0
Sál bed-posts, 7′ × 2½″ × 2½″ ,, ,,	12	8	0	,,	15	0	0
Bamboos of 9′ to 10′, per 100 score ,,	50	0	0	,,	200	0	0

S. EARDLEY-WILMOT,

Offg. Conservator of Forests, Central Circle,

N.-W. P. and Oudh.

V. Notes, Queries and Extracts.

THE UTILITY OF FORESTS AND THE STUDY OF FORESTRY.*—The Committee of the Society of Arts was kind enough to ask me to read a paper before this Section of the Society, either on Indian forestry or forest science. When this invitation reached me, I had undertaken to read a paper before the Royal Colonial Institute on "Forestry in the Colonies and in India." This prevented my selecting Indian forestry for the subject of my paper on this occasion—a choice which would otherwise have been most appropriate. Under these circumstances I propose to offer to-night a few remarks on the general utility of forests, and the study of scientific forestry. I trust that the present paper will serve as a useful companion to that which I propose to read before the Royal Colonial Institute on the 14th of next month.

At the outset it seems desirable that I should draw attention to the difference which exists between the terms "wood" and "forest." Under wood, woodland, or plantation we understand an area of defined limits which is stocked with trees or shrubs and managed for the production of timber, firewood, and such other produce which ordinarily accompanies the rearing of trees. Forest, on the other hand, conveys to us something more. If we go back to old English history we find that it meant principally a tract of country which was stocked with deer; such tracts might contain trees or not. Even in the present day some of the Scotch deer forests contain no trees at all, though in most cases woods are thrown in.

From the oldest times the forests were, under special laws, called "forest laws," and we frequently read how they pressed heavily on the people and how they were limited in their operation from time to time. Even in our own days we hear a good deal of agitation against the maintenance of the Scotch deer forests.

With the increase of population and the extension of cultivation land became more valuable and the extent of the forests in the old sense decreased. Considerable portions of the English

* Paper read before the Indian Section of the Society of Arts, London, on 7th February, 1890, by DR. W. SCHLICH.

forests were planted, so that a forest now conveys to our mind a tract of country which consists of a series of woods of greater or smaller extent, separated more or less by bare spots. This is, for instance, the picture which the well-known New Forest now presents. In other European countries the economic principle prevailed at a much earlier period and to a greater extent, and there forests mean now-a-days tracts of country covered throughout with trees and shrubs which, as a rule, are subject to special forest laws providing for their proper protection and other matters.

Although forestry has been practised in the United Kingdom for centuries, it did not receive much attention until the progress of forestry in India required the appointment of properly qualified experts, who could not be procured in this country. In 1864, Dr. D. Brandis (now Sir Dietrich Brandis, K.C.I.E.) had been appointed the first Inspector-General of Forests to the Government of India, and that eminent organiser perceived at once that if forestry in India was to be really successful and lasting, it was necessary to secure the services of an efficient staff to manage the extensive forests of our Indian Empire. First, two forest experts were obtained from Germany to assist Sir D. Brandis in introducing systematic forest management into India, and shortly afterwards arrangements were made to train a certain number of young Englishmen in forestry in Germany and in France. Then people began to ask why these young men could not be trained in this country, and thus the ball was set rolling. It could not, however, be denied that we had nôt the means of instruction nor forests which had been systematically managed for a sufficiently long time to serve as training-grounds. Although our foresters are equal, if not superior, to those of any other country, as far as planting woodlands is concerned, there was no denying the fact that the management of the areas so planted left much to be desired. Only a limited area of forests is in the hands of the Crown, and these are held under peculiar conditions, while the bulk of the forests belongs to private owners, whose management is governed by considerations which may, and often do, change from year to year. Under these circumstances it was but natural that the Indian Government had its future forest experts trained where they were likely to learn most, and that was in Germany and France.

However, the matter was kept before the public, and for three years a Parliamentary Committee deliberated on the question "whether by the establishment of forest schools or otherwise our woodlands could be made more remunerative." The outcome of this Committee was disappointing.

In the meantime difficulties had arisen in connection with the training on the Continent, and Her Majesty's Secretary of State for India decided to start a forest school as a branch of the Royal Indian Engineering College, Cooper's Hill, where the candidates for appointments in the Indian Forest Department receive now their theoretical training. This took place in 1885.

Quite lately a course of instruction in forestry has been started in connection with the University of Edinburgh by Dr. Somerville, who has himself studied forestry at the University of Munich, in Bavaria. These matters have changed the aspect and position of forestry in this country, and it seems to me that I shall not be wasting an hour of your time by giving you a short account of the general utility of forestry, and of what is understood under the term, "the study of forestry."

I.—*The Utility of Forests.*

To enable us to judge of the claims of forestry, it is necessary to consider in what the general utility of forests consists, and in how far they become of importance in the case of any special country. Many pamphlets and books have dealt with the subject, and in many respects the most contradictory views have been advanced, especially as regards the indirect effects of forests. I have lately published the first volume of a "Manual of Forestry,"* in which I have given a summary of the utility of forests, in so far as it has been established by experience, up to date. In this place it must suffice to state that forests are of value through their produce and through the influence which they exercise upon the climate, the regulation of moisture, the stability of the soil, the healthiness of a country, and allied subjects. We all know that, besides timber and firewood, forests yield a great variety of other or minor produce—articles such as bark, especially for tanning, turpentine, resin, caoutchouc, gutta-percha, catechu, numerous dye stuffs, flowers, fruits, fibres, grass, moss, peat, bamboos, canes, shellac, honey, wax, and many others. Most of these articles are of importance to the welfare of mankind in one way or another.

Next, forests are important objects of industry in representing a large amount of capital,† and because they provide work in a

* Published by Messrs. Bradbury, Agnew & Co, Bouverie Street, London, E.C.

† The woodlands of the United Kingdom may be estimated to represent a value of not less than £100,000,000. The forests of Germany are valued at £1,000,000,000.

variety of ways, partly in connection with the administration and working of the forests and partly in yielding the raw materials for an endless variety of industries. This part of the subject is one of special interest, but want of space prevents my entering more fully into it.

The indirect effects of forests are produced by agencies, of which I may mention the following :—

(1). The crowns of the trees, which interrupt the rays of the sun and the falling rain, obstruct the movement of air currents and reduce radiation of heat during the night.

(2). The fallen leaves, flowers, and fruits, together with mosses which grow in the half shade of trees, form a layer of mould, or humus, which protects the soil against changes of temperature and influences the movements of water and air in the soil.

(3). The roots of the trees penetrate into the soil and bind it together.

Owing to these agencies, areas covered with forest are subject to influences which do not exist on bare lands. As to the actual extent of the effect, views have varied considerably ; some writers have been carried away by exaggerated confidence, while others distrusted the reality of the effects altogether. In more modern times, however, accurate and systematic observations have been introduced, not only in Europe, but also in India and other countries. Such observation became of special value since the introduction in 1867 by Professor E. Ebermeyer, of Munich, of so-called double or parallel stations, one being situated inside a fully-stocked forest and the other at some distance from its boundary, in the open country ; all other conditions, such as elevation, soil, &c., being, as near as possible, the same in both cases. The Indian observations do not as yet extend over a sufficiently long period to have yielded decided results, but those made in Germany, France, and Switzerland have settled many questions, while they have thrown additional light on others on which, as yet, final conclusions have not been possible.

As far as our knowledge goes at present, the following summary indicates generally the utility of forests in the economy of man and of nature :—

(1). Forests supply timber, fuel, and other forest produce.

(2). They offer a convenient opportunity for the investment of capital and for enterprise.

(3). They produce a demand for labour in their management and working, as well as in a variety of industries which depend on forests for their raw material.

(4). They reduce the temperature of the air and soil to a moderate extent, and render the climate more equable.

(5). They increase the relative humidity of the air, and reduce evaporation to a considerable extent.

(6). They tend to increase the rainfall.

(7). They help to regulate the water-supply, insure a more sustained feeding of springs, tend to reduce violent floods, and render the flow of water in rivers more continuous.

(8). They assist in preventing landslips, avalanches, the silting up of rivers and low lands, and arrest moving sands.

(9). They reduce the velocity of air currents, protect adjoining fields against cold or dry winds, and afford shelter to cattle, game, and useful birds.

(10). They assist in the production of oxygen and ozone.

(11). They may, under certain conditions, improve the healthiness of a country, and under others endanger it.

(12). They increase the artistic beauty of a country.

Although forests may be useful in a great variety of ways, it depends on the special conditions of each country whether they are necessary or even desirable. No general rule can be laid down in this respect. As regards the direct effects of forests, it is necessary to consider the position of a country, its communication with, and the control which it exercises over, other countries, the quantity and quality of substitutes for forest produce which are available in the country, the value of land and labour, the returns which land yields if used for other purposes, the density of population, &c. Since these matters differ from place to place, it follows that the forest policy of various countries has taken different shapes. Thus it has been brought about that at the present moment the forest area in the countries of Europe ranges from 4 per cent. of their total areas to 48 per cent., namely :—

	Per cent.
United Kingdom, ...	4
Holland, ...	7
France, ...	16
Norway, ...	25
Germany, ...	26
Hungary, ...	29
Austria Proper, ...	33
Sweden, ...	42
Russia, ...	42
Servia, ...	48

Even a superficial consideration will show that Great Britain,

with its extensive coal-fields, iron industry, sea-bound situation, minute system of railways, and moist climate, does not require as much forest as, for instance, Russia, which is subject to conditions of an almost opposite nature, or even Germany, as long as the necessary timber can be obtained at a reasonable rate from other countries. Whether the latter will be always practicable is, however, by no means assured. During the years 1883-87, for instance, we have imported nearly 6,000,000 loads of timber every year from the following countries :—

	Loads.
Russia (northern ports), ...	1,333,139
Sweden, ...	1,506,852
Norway, ...	728,111
Germany, ...	346,189
France, ...	348,771
The United States of America, ...	373,089
Total, ...	4,636,151
Canada, ...	1,233,516
Grand Total, ...	5,869,667

Of this material, about 4½ millions were from countries over which the British Government has no control; and even as regards the colony of Canada it can only advise. It follows that these sources of supply may fail either from a gradual exhaustion of the forests or from political reasons. Now, all the timber included in the above figures is of such a nature that it could be replaced by timber grown in these islands. It is also a fact that the United Kingdom contains an area of 26,757,000 acres of barren mountain land, bog, marsh, waste land, &c., of which a considerable portion is fit to produce timber, and it has consequently been urged that such lands should be brought under forest. The difficulties which face such a scheme are, no doubt, great; the lands in question are private property, they are in many cases required for grazing purposes, the creation of forests requires a certain outlay, and they would not yield any substantial return until after a considerable lapse of time. Moreover, the present prices of timber are very low, whereas waste lands let as shooting grounds give immediate and very often substantial returns.

And yet a good deal could be done towards increasing the area of our forests without interfering with present returns to any appreciable extent. To proceed in a wholesale fashion in such a case is always courting failure at the very outset. On the other hand,

the returns from many of the estates could be considerably increased by putting the better parts of the land under wood.

Only a few months ago I passed over an extensive tract of land, which is now let for deer shooting, at an annual rental of £2,000. On inquiry I found that the area included in the lease amounted to about 30,000 acres, so that the owner received about 1*s.* 4*d.* per acre a year, which is, after all, not a very high return. A good portion of the land was situated above the upper limit of profitable tree-growing, but a big slice contained unmistakeable signs of having once been a very fine Scotch pine forest. Indeed, I saw there the biggest Scotch pine tree which I have ever seen. Now this land could be made to yield a great deal more than 1*s.* 4*d.* per acre, if stocked with Scotch pine—an operation which, if done judiciously, need not reduce the rental from deer-shooting. I have seen many other similar cases in Scotland, where the yielding power of estates could be considerably increased if their management was approached in a somewhat more enlightened manner.

Other sea-bound countries are, in many respects, situated as Great Britain, and the forest question is not pressing. In the same degree, however, as we proceed from the Atlantic Ocean in an easterly direction to the continental countries matters change. The same extensive coal-fields and means of transport are no longer available, and the necessary forest produce has to be grown on the spot. At the same time the climate becomes less moist, the rains are less favourably distributed over the year, extremes of temperature become more pronounced, and the indirect effects of forests more important. In consequence of these conditions, continental countries, more particularly Germany, recognised the importance of maintaining a certain proportion of the land under forest at a comparatively early time. In that country systematic forestry, as now understood, was introduced with the commencement of the present century, passing over here the more incomplete measures taken at earlier periods. The rise of the scientific and systematic treatment of the forests in Germany was principally inaugurated by three men—Hartig, Cotta, and Hundeshagen—who were followed by quite a host of others up to the present day. The result of their labours is, that in no country of the world are forests treated in an equally efficient manner, and other nations had from time to time to go to Germany to learn what really successful forest management implies. In Germany an area of 34,350,000 acres—equal to 26 per cent. of the total area—is at present under forest. Of this area, 33 per cent. belong to the State, 19 per cent. to corporations and endowment funds, and 48

per cent. to private persons. The former two, or 52 per cent. in all, are under the direct control of the State authorities, while the private forests are subject to supervision in as far as they affect the welfare of the general community.

And here I may say a few words about State interference in the case of forests. Where forests are not essential on account of their indirect effects, and where the importation of the necessary produce from other countries is easy and assured, the State, as such, need not as a rule take measures to maintain or acquire forests, but where they are required on account of their climatic and mechanical effects, and where importation is uncertain or impracticable, a wise administration will take measures to insure the maintenance of a suitable proportion of the area of the country under forest, either by constituting a certain area of State forests or by controlling the management of corporation and even private forests. In the case of the latter, interference is only justified when the welfare of the general community requires it.

This case has, up to date, not arisen in these islands, hence such interference has not been introduced by law, and seems repugnant to the mind of an Englishman. In continental countries matters are different, and if there the State did not interfere, timber and firewood would in many cases reach prohibitive rates, or become altogether unprocurable. The extent to which such interference is carried depends on the special conditions of each country. Suffice it to say that it is exercised in most continental countries. India has followed a similar policy during the last 30 years, and the matter has of late attracted the attention of the Governments of many of our colonies, with what effect I propose to show in another place.

As the consequence of all this, the study of forestry has received a powerful impetus in this country. And this brings me to the second part of my task.

II.—*The Study of Forestry.*

Forestry ascertains the principles according to which forests should be managed, and applies these principles to their treatment. The first part is called "forest science" and the latter "practical forestry."

As forests occupy a portion of the land, it follows that forestry really forms part of agriculture in its widest sense; it is essentially an "industry." As long as the land of a country is valueless, or nearly so, this is not felt; but in the same degree as the

value of the land rises, the industrial character of forestry becomes more and more apparent, and in the more civilized countries, especially of Europe, forestry is expected to teach how forests should be managed, so as to realize, in the most advantageous manner, the objects for which they are maintained. Now, this opens up the whole question: "The objects for which forests are maintained." What are these objects? The answer is a long one, but it may perhaps be condensed to the following points :—

(1). The object of maintaining a forest may be to yield produce of a definite description ; for instance, trees which give a certain class of timber or other produce fit for particular purposes, or trees and shrubs of special beauty.

(2). In other cases the object may be to produce the greatest possible quantity of wood or other produce per acre and year ; for instance, a proprietor requires annually a certain amount of timber and fuel for his estate, but does not wish to set aside for this purpose more area than he can absolutely help ; in this case the management would have to be so arranged that each acre yields the highest possible quantity of produce.

(3). In other cases the owner desires to derive the highest possible annual income from his land.

(4). In other cases the owner seeks to derive the highest possible interest on the invested capital, cases by no means identical with those mentioned under (3), because the different methods of treatment require different amounts of capital and yield different returns.

(5). In many cases the object is to produce certain indirect effects ; for instance, to influence the climate of a country, to regulate its drainage, preserve the stability of the surface soil, prevent landslips, sudden floods, the silting up of low lands, the formation of avalanches, afford protection against cold or hot winds, &c.

Now each of these and many other cases demand a distinct method of treatment, and probably also the growing of particular species of trees ; but the matter does not end here. An essential point of rational forestry is not to injure the permanent value of the property in realizing the particular object of management. On the contrary, the management should be so arranged that the present generation takes only its proper share, nor should future generations be favoured at the expense of the present ; in other words, the land should be made to yield now as much as it can without endangering its yield capacity in the future.

It is the business of the forester to deal with all the questions involved in the above-mentioned matters. There are people who understand, under a "forester," a man who goes about with a heavy axe over his shoulder, and a couple of pruning instruments by his side, ready to cut and to prune as he goes along, and who, at certain times of the year, plants young trees where old ones have been removed. Such a man is, no doubt, a forester, in fact, a practical forester or woodman. At the same time, the State or other large owner would be very foolish to entrust the decision of all the intricate questions on which I have touched to a man of that class. To deal with the questions of forest policy generally, and to devise the system of management applicable to forests under varying conditions, requires something more than the capacity to swing an axe and to plant a tree. An expert who can be safely left to deal with these matters must be skilled not only in practical forestry, but also in forest science; and the question now before us is, what does this imply? Well, it means that a forest expert requires, in the first place, to be an educated man, with a well-trained mind. But this is not enough; he requires also a knowledge of special branches of learning. He must be acquainted with the elements of law and of political economy, so as to judge of the provisions of the forest laws, and understand forest questions in so far as they concern the welfare of the State as a whole. Next, he must be acquainted with chemistry and physics, or else how could he understand geology, mineralogy, zoology, and botany, which form the very foundation of his business? One of the principal requirements of a forest expert is to understand the effect of soil and climate upon forest vegetation and *vice versâ*. For this purpose, he must be acquainted with the chemical and physical qualities of the soil, with the factors of the climate, heat, light, the movement of moisture in nature, the law of air current, &c. Then, botany in all its branches is indispensable, because the forest expert must not only be capable of determining the various constituents of forest vegetation, but he must also understand the mode of growth of trees and plants and the diseases which plants, especially fungi, bring to trees. And last, but not least, he must understand entomology, which deals with the insect enemies of forests.

Having enumerated all these things, I have, after all, only arrived at the threshold of forest science. In fact, the branches of learning mentioned above are, from this point of view, generally called the "auxiliary sciences." Forest science proper is generally divided into two main branches; the first of these teaches how to produce forests and the second how to manage them.

"Forest Production" may be divided into the following four sections :—

(1). Locality in relation to forest vegetation.

(2). Sylviculture, or the creation, regeneration, and rearing of woods, until they become ripe for the axe.

(3). Forest protection, which teaches how forests may be protected against man, animals (especially insects), plants (especially fungi), climatic influences, natural phenomena, &c. Such protection is afforded partially by laws passed by the Legislature of the country, but chiefly by appropriate measures taken by the owner of the forest.

(4). Forest utilization, which deals with the technical qualities of timber ; consumption of wood ; the felling and shaping of trees ; the disposal and transport of wood ; the harvesting of other forest produce, such as litter, grass, fruits, bark, turpentine, caoutchouc, dyes, fibres, &c. ; the impregnation of timber, forest saw-mills ; manufacture of charcoal, &c.

The second branch, "Forest Management," deals with all the parts of forest science which influence the management, and of which I may mention :—

(1). Forest policy, or consideration of the objects of management. This branch is based upon statistics, and it necessitates the elaboration of a method by which the interest derivable from the invested capital and the yield capacity of estates can be readily ascertained.

(2). Forest organization, or the principles according to which the general management of forest estates should be arranged.

(3). Forest mensuration deals with the determination of the volume (or cubic contents) of trees and woods, their age, and past and probable future increments.

(4). The working of forests. Here the yield is ascertained and plans drawn up, which regulate the due execution of all forest operations, such as final cuttings, thinning, pruning, planting, and all other works, and all this in strict accordance with the objects of management.

The mere enumeration of these branches of study shows that forest science is a superstructure erected on the basis of many other branches of learning. Forestry is, however, also based upon empirical knowledge ; hence the study of forest science, if it is to be fruitful, must go hand in hand with practical instruction in the forest ; in other words, forest science and practical forestry must go together, neither the one, or the other by itself makes a forest expert. In the same way as the medical student walks the hospitals

while he hears lectures on the various branches of medical science, so must the forest-student walk the forest as a necessary supplement to his studies in the class-room.

The importance of employing really competent men in the management of forest estates, whether belonging to the State or to private owners, has led to the establishment of forest schools in most European countries. There are nine such schools in Germany alone, some forming part of universities, others being attached to higher technical schools, and some being independent institutions. Most of these are first-class schools, where the instruction is given by a considerable number of professors. To show the position which they take, I may mention that last year the principal Professor of Forestry at Giessen, Dr. Hess, filled the post of honour of Rector of the University, and this year Dr. Gayer, Professor of Forestry, holds the same position in respect of the University of Munich. The fact is, that in Germany the Forest Department holds the same rank as other branches of the administration, and a Forest Officer, who has gone through the prescribed course of education, is eligible for, and actually does reach, according to eminence, the highest posts in the *ressort* of the Ministry, to which the Forest Department belongs. I must, however, add that the standard of education is on a par with that of the other branches of the administration, and it takes a forest student, after leaving the grammar school, about six years to qualify finally for the upper branch of the service. France has a first-class Forest School at Nancy, and the forest service of that country stands on a footing similar to that which it enjoys in Germany.

Turning now to this country, we find at present two places where scientific forestry can be studied. As already mentioned, Dr. Somerville has commenced instruction in connection with the University of Edinburgh. The undertaking is quite in its infancy, and I am not in a position to say much about it. Dr. Somerville is now giving his first course of 100 lectures, in which he proposes to deal with certain chapters of botany and forestry. His principal difficulty is due to the absence of systematically managed forests in Scotland, where the theories taught in the class-room could be sufficiently demonstrated. As far as I am aware, the Scotch forests now in existence belong all to private owners, whose forest policy depends chiefly on the following considerations :—

(1). The æsthetic effects of their forests.

(2). The state of their exchequer.

(3). The returns which their lands are capable of yielding, if used as shooting grounds.

(4). Family considerations—whether the forests go, at the death of the present owner, to his own children or some other branch of the family.

It is against human nature to expect systematic management extending over long periods, as long as the estates are subject to such considerations. At the same time it will be a difficult task to bring about a change in these matters.

The Forest School at Cooper's Hill was established in 1885, and it forms part of the well-known Royal Indian Engineering College at that place. The whole institution belongs to the Government of India, and is consequently under the orders of Her Majesty's Secretary of State for India in Council. The President of the College is General Sir Alexander Taylor, G.C.B., R.E. We commenced in a modest way, and gradually developed the establishment. Hitherto the course of instruction has comprised 26 months, but it has now been decided to extend it to three years.

According to the requirements of the Indian Service, a number of young men (twelve at present) are selected annually by means of a competitive examination held by the Civil Service Commissioners. They must be British-born subjects, over 17 and under 20 years of age. The Entrance Examination will in future be arranged on the same lines as the so-called "Further Examination" for admission to the Royal Military Academy at Woolwich. There will be only three obligatory subjects, in which each candidate must satisfy the Commissioners, namely—English, German, and mathematics (arithmetic, algebra, euclid, plane trigonometry, mensuration, and elementary statics and dynamics). For the rest each candidate may choose a maximum of three subjects from amongst the following :—Higher mathematics, French, Latin, Greek, English history, chemistry, physics, physical geography, and geology. Over and above these, he may take up English composition, freehand drawing, and geometrical drawing, if he chooses to do so.

The object is to enable young men who have passed through one of our first-class schools to compete successfully without extra preparation by a special establishment.

The successful students enter the college in September, and of the time set apart for instruction, two years, or six terms, are spent at the college, and the last, or seventh term on the Continent. Under the revised arrangement, which is expected to come into force this year, the students will spend eight terms at the College, and be instructed in the following subjects :—

By the Staff of the Engineering Branch of the College.

1. Inorganic Chemistry.
2. Physics.
3. Geology and Mineralogy.
4. Accounts.
5. Surveying.
6. Road Construction.
7. Drill and Gymnastics.
8. Geometrical Drawing.
9. Freehand Drawing.
10. German.

By the special Professors of the Forest Branch of the College.

11. Chemistry of Soils and Vegetation.
12. Entomology.
13. Botany.
14. Forestry.
15. Elements of Law and Political Economy.

In subjects 1 to 7 the instruction is the same as that prescribed for engineering students. The instruction in geometrical drawing ceases at the end of the second term. In freehand drawing and German extra instruction is provided.

The instruction in chemistry of soils and vegetation is at present given by Professor A. H. Church, M.A., F.R.S.; the instructor in entomology is W. F. H. Blanford, Esq., M.A.; for botany we secured from the beginning Professor H. Marshall Ward, M.A., F.R.S., F.L.S., whose eminence in this branch is well-known. The instruction in botany extends over elementary biology, organography, anatomy, systematic botany, physiology, and pathology; it comprises about 170 lectures, with work in the botanical laboratory, excursions to the country surrounding the College, and regular visits to the Kew gardens and museums.

For the instruction in the elements of law and political economy we hope to secure the services of a retired member of the Indian Civil Service, who has written an excellent work entitled "A Manual of Jurisprudence for Forest Officers."

The instruction in forestry has up to date been given by me; it is now contemplated to engage a second professor of forestry, and to double the amount of instruction hitherto given. The instruction extends over the several branches indicated above, and will comprise, under the revised arrangement, about 280 lectures, supplemented by practical instruction in our forest nursery in the adjoining Windsor forests, visits to more distant forests, such as

the Esher oak forests, the beech forests around High Wycombe (in the centre of the chair manufacture), the New Forest, Forest of Dean, and High Meadow Woods and the forests of several noblemen in Scotland. Amongst the latter those belonging to His Grace the Duke of Athole, the Earl of Mansfield, the Countess Dowager of Seafield, and Lord Lovat have of late years been regularly visited in the autumn ; on these occasions we also visited the large nurseries of Mr. Gossip at Inverness.

As already indicated, the practical instruction cannot at present be completed in the country ; hence at the completion of the course at the college the students who have qualified in the various subjects of study proceed to the Continent, where they are taken charge of by Sir Dietrich Brandis, who during a period of not less than three months takes them to a number of the most interesting forest districts in Germany, Switzerland, and Austria, where they study the management of forests, which have been under systematic treatment for a long period. I need hardly add that our students could not be in better hands. Sir D. Brandis possesses not only a vast store of knowledge, but he also insists on the students making full use of their opportunities.

This brings the instruction to a close, and the young men proceed then to India to take their place in the Forest Department of that country.

We have established at Cooper's Hill a forest museum, a botanical and entomological laboratory, and a forest nursery, besides the already existing chemical and physical laboratories. By the kindness of the Commissioners of Woods and Forests we are placed in direct communication with the Deputy Surveyors of the Crown forests, who do all in their power to assist us. The Windsor Crown forests are within easy reach of the college, and they afford most excellent means for the study of forest botany and arboriculture. As to the study of sylviculture, they are, however, not adequate to our requirements, for reasons which are due to the objects for which these forests were maintained—a subject upon which I need not enter here. Suffice it to say that there is a sufficient area of forest land outside Great Windsor Park for the purposes of instruction, and we are now in treaty with the Commissioners of Woods and Forests, with the view of an area of 1,000 acres being made over to our management, and of their gradual conversion into a proper training ground for forest students. I have every reason to believe that an agreement will be come to at an early date.

And here I may add a few general remarks on this subject. As

long as we have not a sufficient area of forests in this country which has been subject to systematic management on economic principles for a considerable period, our forest students must go to the Continent to see and study the management of such forests. But it seems to me that, considering the importance of the matter to India, our vast colonies, and the mother-country itself, we should not lose another moment to put certain forests in this country under systematic management, and to make sure that they continue to be so managed. It would be hopeless to expect private proprietors to do this, and we naturally turn to the areas at the disposal of the State. Now, there are certain areas under State management, the so-called Crown forests. They do not, however, belong to the State, but to the Crown, and consequently they are not altogether at the disposal of the former. In the general interest of forestry, however, an effort should be made to secure suitable parts of the Crown forests for our purpose, and I do not see why this could not be arranged. The management of these woodlands proceeds now on special lines, and the Commissioners of Woods and Forests, though ready to meet our requirements, will only do so by being paid for it, because they plead that they are expected to make the most of the estates. They put a high price on their land, because they count on its being taken up for building purposes.

While admitting that nothing can be said against the views of the Commissioners from their own point of view, I think the State, as such, should take a wider view of the matter, and arrange for the management of a suitable selection of areas, with the view of their becoming patterns of systematic forest management. Such a step would doubtlessly be of great benefit, not only to the mother-country but also to India and the Colonies. And, what is more, it could be done without in any way reducing the income now derived from such lands; on the contrary, these forests would gradually become more valuable and yield an increasing return. The areas so treated would be available for any forest school which may be started in this country; but as Cooper's Hill is most favourably situated in respect of suitable Crown lands, it would be as well to develop the already existing school and to adapt it for the requirements of students who propose going to the Colonies, and for forest experts who desire to work in this country. Such students, if sufficiently grounded in the auxiliary sciences, need not necessarily go through the three years' course prescribed for Indian students; shorter courses suited to their requirements could easily be arranged with a comparatively small additional outlay.

Pending a further development of the College in the direction indicated above, I may mention that under present arrangements students not nominated for the Indian forest service are received at the College as far as the available accommodation permits. Such students may pass through the course of instruction prescribed for the nominees of the Indian forest service, or they may be permitted to participate in the instruction given in certain subjects only. On attaining a prescribed standard, the student will receive, according to circumstances, either the College diploma in forestry, or special certificates showing in what subjects they have followed the instruction, and with what result. Students of the latter class will be required to abide by the general rules of the College, but they are not obliged to reside in it. If they elect to live outside they will only pay for instruction according to the subjects which they take up.

Thus it will be seen that we have the nucleus of an institution which only awaits the full support of the Colonies and of the mother-country to develop into an institution worthy of the best forest schools on the Continent. There is no reason why such an institution should not be self-supporting. At any rate, the contribution on behalf of the State would be infinitesimal if compared with the interests that may be endangered if the forests of the British Empire are left uncared for, or their management is entrusted to hands which are not competent to do justice to them.

This completes the remarks which I propose to offer to-day. I trust that I have succeeded in demonstrating the importance of employing only fully competent forest experts in the management of forest estates which are treated on economic principles. Competition has become so acute in these days that the area of mere landscape woods is becoming more and more contracted, though the two objects can, to a considerable extent, go hand in hand. As to our Indian Empire and many of our colonies, the maintenance of a sufficient area of forests has clearly become the duty of their Governments. India has recognised this duty some time ago; most of our colonies are, however, still playing with the question. Let us hope that they will awake to real earnest work in this direction before it is too late. It takes a long time to grow a tree, but a short time to cut it down; hence foresight and continuity of action are of greater importance in the case of forestry than in almost any other branch of industry.

Discussion.

Sir Charles Bernard, K.C.S.I., said this very interesting paper had shown conclusively that the maintenance, improvement, and

proper administration of forests were of very great importance to any country. Most of those present being specially interested in India held the strongest views about the utility of the Indian forests and the desirability of administering them to the best advantage for future generations through the agency of a well-instructed department meeting under the executive Government of the country. In India there were laws for each province under which the forests were arranged, and probably the whole area of the empire under forest was about 15 or 16 per cent. of the whole, but at present the area of forests under Government management was not more than about 8 or 9 per cent. The forest administration in India began many years ago under the auspices of the Chairman ; it had been carried on by Sir D. Brandis, and next to him in the history of Indian forestry came the name of Dr. Schlich, who, carrying on the work of Dr. Brandis, had organized the Forest Department as it now existed. The total revenue, which began with nothing, was now nearly 1½ million sterling per annum, and the net revenue was nearly half a million sterling—a very good result At first a great deal of apprehension was felt by some of the natives and others that the taking over of these large areas by the Government would operate to the injury of those who lived near and who had certain rights of use in them ; but as Dr. Schlich had told them with regard to the German forests, the amount of employment afforded in various ways by the proper management of these forests was very large ; and though this did not operate to so great an extent in India, still the State management of these forests supported a large population in much greater comfort than they had enjoyed 40 years ago, when the forests were under the management practically of no one at all. At the present time the forests were used partly as grazing grounds and partly as timber-producing areas, in every case those who grazed cattle or cut timber paying a little for the privileges they enjoyed. Formerly some paid a little, but most did not, and those who paid did so, not to the State, but to those who had in one way or another possessed themselves of the forest areas. There were still considerable forests in Bengal and other provinces, the property of private persons, which were now being exploited in a most wasteful way, and before another generation they would probably be improved off the face of the earth, and then there would only remain the State forests under the management of the department constituted by Dr. Brandis and Dr. Schlich. He had been much interested in the account Dr. Schlich had given of the School at Cooper's Hill, some pupils from which had already gone out to India, and he could

testify that they were an admirable set of young men, and he hoped that the example thus set would be followed both in the Colonies and in the mother-country, so that the important subject of forestry should receive due attention.

Mr. B. H. Baden-Powell, C.I.E., said there were two points not yet mentioned which he thought worthy of notice. He hoped this paper would not be considered as an Indian paper, though it was read before the Indian Section of the Society. It was a general paper, not confined to Indian forests, and if it served to call the attention of the Colonies to the matter, it would do a great work. To those who had been in India and knew the importance of managing forests on a systematic scale, it seemed perfectly amazing that in none of the most important colonies did any Forest laws exist. His own experience had been mostly in connection with forest legislation, and matters connected with rights in forests, but amongst all the laws sent him for review, with the exception of some slight regulations in Cape Colony, there were no laws at all relating to forests. He had never seen such in any of the Australian States, nor in Canada, which ought to be the most important forest country in the world. This was a most astonishing fact, but it would only become astonishing to the public when the utility of forests was thoroughly understood ; and if this paper only had the effect of arousing public attention to the immense importance of properly managing the colonial forests, it would be most useful. The other remark he wished to make was this. A few years ago it was more common than it was now—though it was not entirely unknown still—to hear remarks made by some people on the selfishness of Governments in shutting up large areas of public forests, as if the Government got some personal benefit, and did not manage the forests for the public benefit. It was said that the effect of forest conservancy was to deprive the poorer inhabitants of grazing their cows and goats, and of doing all the little mischiefs which they loved to do in forests. But that was a great mistake ; if a forest were properly conserved, it did not diminish the legitimate satisfaction of the requirements of the villagers and other population, but, on the contrary, absolutely increased that enjoyment. If you gave a child a whole cake, it would make itself sick, and destroy the cake in a very short time. It was just the same with a village ; if it managed its own forest, it set fire to the grass, in the vain idea of getting a crop of young shoots for its cattle ; it cut down a young tree when a plough-beam was wanted, without thinking that if it were left for a few years, it would be fit for something else ; the whole forest was wasted and in a few

years disappeared, and then the people went to the conservators of the next forest, and begged for the privileges which they no longer possessed in their own. If the Government insisted on having the forests properly managed, and if they gave out the cake slice by slice, it was much more wholesome, and lasted longer.

Sir Joseph Fayrer, M.D., K.C.S.I., F.R.S., confessed to some little disappointment at not hearing, as he had expected, something about the present condition and progress of the great Indian forests, but at the same time the paper was a most excellent one on the general subject. This was the first time he had had an opportunity of listening to a scientific expert speak on the subject of forestry, and he was glad to hear what he had said as to the steps which were being taken to train a set of scientific foresters; he hoped, however, they would not be too scientific, or encumbered with too many examinations, or when they got to India they might be so exhausted that the forests would not benefit much by their aid. His own opinion was that if they were thoroughly educated in the first instance, and instructed in the elements of chemistry and botany, with perhaps one or two other branches of science, it would be quite sufficient. He believed that under the guidance of Dr. Schlich and his colleagues they might attain, in this country at least, sufficient elementary knowledge to enable them to start in India, where, after all, the real work of their life lay. As Dr. Schlich had said, when they arrived in India they were not experts —how could they be in so short a time—but they ought to be thoroughly trained in the elementary branches of knowledge, so that they might be able to put their knowledge into practice when they got to India. Few people realized how much they were indebted to those distinguished men, General Michael and Dr. Cleghorn, who had been the pioneers of forestry; and still less did they appreciate how much India owed to the Forest Department, or recognize how much the health and material prosperity of the country were affected by the growth and development of the forests. It would be presumptuous for him, before such an audience as this, to state the various reasons why forests should be encouraged, or attempt to point out what had been the effect on countries in which this culture had been neglected. Palestine, Greece, and many other countries, where deforesting had been allowed to go on, were examples, and their present condition compared with that of past times would give some idea of what the neglect of forestry implied. The same thing might be seen in many parts of that great country with which many present were familiar. In desert regions of the worth-west of India rivers had disappeared—sunk

into the sand—and populous States had vanished as a result, to a great extent, of the annihilation of forest growth in those countries. They had heard of some of the influences of forests—a cooler and more temperate state of the atmosphere, a better supply of ozone. There was a familiar example in that great belt of low forest land called the Terai. Some said, "Cut it down, because it is malarious and kills people." So it does, but for every one it kills, it probably saves thousands in other ways, through the influence of the trees and the vegetation. Those trees sent their roots into the ground, and under their shade were developed the lower forms of vegetable life. These roots prevented the too rapid draining away of the water; but for this the water which fell on the south of the Himalayas would rush away in torrents, denuding the rocks, instead of being gently diffused, as now, under the favouring influence of these trees. No one knew better than their Chairman that on approaching this great forest region in the month of March or April, when the heat was intense, when you approached the Terai, long before you got into the forest you found a comparatively cool atmosphere. This was owing to the presence of the vegetation which so many would cut down, but which he hoped would be maintained. This was merely an illustration of one of many sanitary reasons why forests should be encouraged, and there were many others. He had no special knowledge of forestry, but took a great interest in it from sanitary considerations, and he believed there was no department from which the Indian Government might look for better results than the one whose cause had been advocated that evening, and for the founding of which India owed much to the Chairman.

Mr. W Smartt suggested that before students of forestry went to India it would be well if they gained some knowledge of the various products which were sent home from that country, many of which came forward in a very imperfect condition. It would also be well if they obtained some knowledge of the timber trade in London. It was a great pity that some one of more skill was not employed in Epping Forest, for instead of allowing the young trees to grow, many had been cut down, and the old pollards were allowed to remain, apparently to give a more picturesque appearance to the landscape. This might improve present appearances, but it resulted in a serious future loss. A large portion of Central Australia had no trees, and it would be an enormous advantage if the Government of that colony could make arrangements for planting it. Of course they would be planting for the future, and the cost of planting a large tract would be very great, and there-

fore the whole of the Australian colonies ought to unite in the work.

The Chairman said Dr. Schlich had given his views very clearly with regard to the utility of forests, and the education required for a forester of the higher grade ; that of a lower grade of woodmen, such as would be required in England, would naturally follow. No one who had visited the great forests of Germany, Austria, and France could fail to be struck with the visible effects of good management, and he wished the same effects were more generally apparent in this country For his own part, he seldom went through a wood or plantation in Scotland or England without wishing he could have something to do with it for a few years. But there were signs that the subject was now attracting far more attention than it did, and there was a better chance of a good practical training for young men wishing to make forestry their study. He ventured to predict that, before many years were passed, Dr. Schlich would have a large number of students at Cooper's Hill, destined for home employment and not for India only. It augured well for their future that they should be in such good hands. Personally he knew more about forestry and a forester's life in India than elsewhere, having spent seven or eight of the happiest and, perhaps, the most useful years of his youth as a forest officer ; that was more than 40 years ago, before the time arrived for experts like Dr. Schlich or his distinguished predecessor, Sir Dietrich Brandis, to come to the front. He could therefore tell any young men who were thinking of taking up this career that it was not only a most important one, but one full of interest and of positive enjoyment. The formation of the Department in which they would serve—and in which Dr. Schlich served so well and successfully—had been justly characterized by Sir Richard Temple as one of the greatest achievements effected in India during the reign of Her Majesty the Queen. He concluded by proposing a hearty vote of thinks to Dr. Schlich.

The vote of thanks having been carried,

Dr. Schlich, in responding, said he need only refer to one remark of Sir Joseph Fayrer's as to the undesirability of teaching the students too much. That idea commended itself to many people, but he had always understood that knowledge is power, and that it was very difficult to teach a man too much. These young men who were trained at Cooper's Hill were to recruit a staff of 180 superior officers who had under them a staff of 12,000 forest officials ; and if those who were to arrange for the management of the forests and to guide the whole concern were not thorough

experts, he failed to see how those who were under them could be expected to do the right thing. He did not think, therefore, that they could be taught too much of their profession.—*Journal of the Society of Arts.*

Depth of Roots.—I have often been interested in noting the ideas most people have as to how far and how deep the roots of plants extend, says Prof. Atwater. The majority guess roots of grass and clover penetrate between 5 and 10 inches, and are surprised to find that they reach several feet. I have some roots of timothy, clover, and other plants dug from a very heavy clay soil—a good quality of brick clay, so compact and hard, that a sharp knife in cutting it, leaves a surface as smooth and shiny as it would cut on the end of a pine board. I have traced the roots of the timothy to a depth of 2 feet and 4 inches and the clover 3 feet and 2 inches. A number of years ago a very intelligent German farmer named Schubart made some very interesting observations upon the roots of plants as they grow in the field. An excavation 5 or 6 feet deep or more was dug in the soil so as to leave a vertical wall. Against this wall a jet of water was played by means of a garden sprinkler, the earth was washed away, and the roots of the plants growing therein laid bare. The roots thus exposed in a field of rye, in one of beans, and in a bed of garden peas presented the appearance of a mat or felt of white fibres extending to a depth of about 4 feet. Roots of wheat sown on September 26th and uncovered on the 26th of April had penetrated 3½ feet, and six weeks later about 4 feet below the surface. In one case in a light subsoil wheat roots were found as deep as 7 feet. The roots of the wheat in April constituted 40 per cent. of the whole plant. Hon. John Stanten Gould, I believe it is, says that he 'has seen the roots of Indian corn extending 7 feet downward': and Prof. Johnson states that the roots of maize, which in a rich tenacious earth extend but 2 or 3 feet, have been traced to a length of 10 or even 15 feet in a light sandy soil. Roots of clover, when growing in a rich mellow soil, extend far both laterally and vertically. Prof. Stockbridge washed out a root of common clover one year old growing in the alluvial soil near the Connecticut River, and found that it descended perpendicularly to the depth of 8 feet. Lucerne roots are stated to reach a depth of 20 and even 30 feet. Alderman Nechi in England tells of a neighbour who 'dug a parsnip which measured 13 feet 6 inches in length, but was unfortunately broken at that depth.'

THE WEATHER IN INDIA.—*October.*—The month of October usually witnesses the completion of the south-west monsoon withdrawal which is commenced in the preceding month. Under normal conditions moist monsoon winds are still felt in Bengal, &c., at the beginning of October, but about the middle of the month dry winds from north-west and north-east, which have already commenced in Upper India, spread over Bengal and the head of the Bay, and occasion the south-west monsoon current to curve to the westward and finally to the south-westward over the centre of the Bay. This current then reaches the Coromandel coast as a north-easterly wind after a long journey over the Bay. During this journey its already large supply of moisture has been augmented by evaporation from the Bay, and hence the very heavy rain which usually accompanies its first appearance on the Madras coast. The recurving of the monsoon current and the extension of dry north-westerly winds from Upper India to Bengal are accompanied by a considerable change of weather. In the first place, cold weather conditions extend quickly over the whole of Northern India ; in the second, the low pressure area, and consequently the area of probable disturbance over the Bay, is moved southward, and the trajectory of the storms is changed from west-north-west across the Orissa coast to west across the Peninsula. In the third place, the Carnatic becomes the seat of heavy and continued rainfall.

The western side of the Peninsula experiences perhaps less change of weather than other parts of the Indian region, as the wind remains westerly and rain falls moderately frequently.

November.—The month of November forms, though less emphatically so than October, one of the autumn transition months during which conditions change from those of the south-west monsoon period to those of the north-east monsoon period. In Northern and Central India the weather is normally fine with a briskly decreasing temperature, while over Bengal and the north of the Bay light north-easterly winds and fine weather alternate with cloudy periods, as the weather in the south of the Bay is disturbed or settled. On the Coromandel Coast the humid north-east winds of the cold weather monsoon ordinarily give heavy rain, while on the western side of the Peninsula, on the contrary, the north-easterly winds are dry and the weather is generally fine. The liability to severe cyclonic storms in the Bay, which is so characteristic of the month of October, is almost as strongly marked in the early part of November. These storms ordinarily originate over the centre of the Bay and march almost due westward (with very slight northing).

December.—It is usual for fine weather to hold over the whole of India till about the third week of December, when pressure usually gives way in the North, and the weather there and often in the Central Provinces becomes unsettled. This unsettled weather usually begins very gradually. The barometer falls for a day or two, ascensional movements of the air take place and clouds appear, then the barometer rises again, the ascensional movement ceases, and a period of very fine fresh weather supervenes. After a time the barometer again falls and this time the oscillation is larger and cycles of this character are repeated till by the close of the month rain falls and a depression is produced. At other times this change of weather is produced by the advance of an already formed depression from Sind and Baluchistan, but on the whole the oscillatory cause is more frequent. It is remarkable that disturbed weather over North-Western India is very commonly coincident with disturbed weather over North-Eastern India, and the rainfall is on the whole heavier over the latter than over the former region. Over the central parts of the country, *viz.*, the Central Provinces, Central India and Rajputana, as well as the Deccan and Konkan, the weather is ordinarily very fine though with a certain liability to small storms either formed over Central India or entering that region from the westward or north-westward. In Sind and Guzerat there is hardly anything more than a few cloudy days. On the Peninsula coasts the weather is liable to be more disturbed. The north-easterly monsoon still gives a good deal of rain to the Carnatic and Ceylon during the first half of the month, and Malabar and Mysore have fairly frequent showers. —*Meteorological Department Reports.*

INFLUENCE OF A COVERING OF SNOW ON THE SOIL AND ATMOSPHERE.—We extract the following extremely interesting and instructive remarks from a review in "Nature" of a work by Professor Woeikof of Vienna :—

"Attention was first drawn to this question by Prof. Woeikof in 1871 in a paper published in the Transactions of the Russian Geographical Society, in which he endeavoured to show that as regards certain portions of Russia, the spring temperature depends very much on the quantity of snow that has fallen in the previous winter, a snowy winter being followed by a cold spring, and *vice versâ*.

"In his recent work, referred to at the head of this article, Prof. Woeikof sums up the present state of our knowledge of the influence of a snow-sheet on the soil, climate and weather. The protection of the ground against frost, which is afforded by a covering of thick and loose

snow has long been familiar, and was, indeed, the subject of detailed observation by E. and H. Becquerell in 1879-80; but additional observations of much value are given in evidence on this head, especially an elaborate series carried on during two years at the Russian Polar station Segastyr, in the Lena delta, in N. lat. 73° 23′. At this place, when the ground is covered with snow during more than six months of the year, the temperature of the coldest month at 1·6 metre beneath the ground surface was found to be less than 1° C. below the annual mean temperature of the surface (alternatively snow or soil) exposed to the air, while that of the warmest month was 15°·4 C. above it. The greater part of this difference of the excess and deficiency must be attributed to the non-conducting layer of snow and the protection thereby afforded against radiation and contact with the cold winds.

"Of the differential cooling effect of a snow-sheet on the atmosphere, as compared with that of a bare land surface, the systematic evidence hitherto available for a rigorous comparison is less extensive than could be desired, owing to the fact that, until recently, but very few meteorological observatories have recorded the presence or absence of snow on the ground. But it fortunately happens that one first-class Observatory, that of Upsala, has done so for a period of fourteen years, and the discussion of these observations forms one of the most interesting and important chapters in the book. Comparing month by month the mean temperatures of all periods during which the ground was under snow with those with an unsnowed surface, Prof. Woeikof finds that the former are lower in November by 4°·7, in December by 5°·1, in January by 6°, in February by 5°·1, and in March by 5°·2 C., respectively equal to 8°·5, 9°·4, 10°·8, 9°·2, and 9°·4 F. The effect of a snow-sheet in lowering the temperature of the air, and in helping to establish anticyclonic conditions, such as prevailed over Central Europe in December 1879, appears, therefore, to be very considerable.

"In discussing the effect of a thick winter snow-sheet on springs and rivers, a variation is pointed out, which is not without importance in its bearings on some points of physical geography. In latitudes where the winter cold is sufficient to freeze the ground to a considerable depth, if heavy snow falls early in the winter before the cold has penetrated deeply below the surface, the protection thereby afforded allows the ground to thaw by conduction from the lower strata, and the water from the slow melting of the basal snow-layer, and much of that which is produced in the spring thaw, soaks into the soil and affords a supply which maintains the streams and springs more or less full through the succeeding summer. But if, before snow falls, the soil has been frozen to a great depth, a rapid thaw setting in in the spring floods the rivers and the surrounding tracts, while little or none enters the ground, and but little supply is stored up for maintaining the summer flow."

A remarkable illustration of the immediately preceding remarks has been furnished this year in the catchment areas of the Jumna and Tons rivers. The first falls of snow usually occur in December, and sometimes even in November, and by the end of December, or early in January the hills in Jaunsar are all covered with snow. Last winter, however, the first fall of snow occurred only on 18th January, when the ground was already frozen to some depth. The result has been that even strong springs have almost completely failed, and the level of the water in the Jumna at Daghpathar, two miles below its confluence with the Tons, was on 17th April, about 6 feet below its usual level on that date. It is true that the snowfall was comparatively slight, but this fact cannot, by itself, account for the entire actual effects observed, for the snow had lain on the ground two whole months, or in other words, long enough to enable the soil to absorb sufficient moisture to keep up the flow of the springs for at least a month afterwards. Actually, the springs began to fail almost as soon as the snow had disappeared.

CONDITIONS INFLUENCING RAINFALL.—The conditions favourable to rainfall, according to Prof. Loomis of Gale University, begin with the fact that the north-east and south-east trade winds, on approaching the belt of calms near the equator, and being gradually deflected upward, are cooled by expansion, so that the aqueous vapour is condensed, and the belt of calms becomes a belt of rain. This equatorial rain-belt, of course, moves with the sun in declination.

A second cause for abundant rainfall is the influence of mountains, for when a strong wind meets a mountain it is forced up the side of the mountain, and elevated into a colder region, the result being that its vapour is precipitated by the cold of elevation.

The rainfall on a mountain from 4,000 to 10,000 feet high may be more than double that at neighbouring places near the sea-level. A third condition favourable to an abundant rainfall is proximity to the ocean, especially when the prevailing wind comes from the ocean. Capes and headlands projecting considerably into the ocean generally show a rainfall greater than interior stations only a few miles distant; and lastly, Prof. Loomis notes that the great and non-periodic depressions of the barometer are always accompanied by a considerable fall of rain, and that the average tracks of these depressions are marked by an excess of rainfall.

The following are some of the conditions unfavourable to rainfall. Fresh winds blowing in a nearly uniform direction throughout the

year, such as prevail within a portion of the system of trade winds, especially in mid-ocean. The rainfall on Ascension Island is quoted as a case in point, observations for two years showing that the direction of the wind was south-east or very nearly so during the time, the rainfall during these two years being 2·31 and 4·30 inches respectively. This condition of things prevails over the Atlantic Ocean within the region where the trade winds blow with considerable force and are seldom interrupted.

A second condition unfavourable to rain is a position on the leeward side of a range of mountains running in a direction nearly at right-angles to that of the prevalent wind. An illustration of this principle is seen on the Malabar coast of Hindustan. On the ocean side of the range of mountains the rainfall is 250 inches annually, whilst on the eastern side of the range the air is very dry, and the amount of the mean annual rainfall is less than 25 inches.

When there is a second range of mountions, parallel and within 100 or 200 miles of the first, the influence of this cause is considerably intensified, and this diminution is still more decided when a place is surrounded by mountains, or nearly so. Salamanca is so situated, and the mean annual rainfall there is less than 10 inches.

Elevated plateaus have generally less rainfall than insulated mountain peaks of an equal elevation; this is illustrated by the fact that Leh, being situated on that remarkable plateau of Tibet, has a mean annual rainfall of less than 3 inches. Another similar case is found in the table-land (the Punos) between two great chains of the Andes; and it is observed that the average height of the Sahara being over 1,500 feet, this elevation may contribute in some degree to the smallness of the rainfall.

Another condition unfavourable to rainfall is the dryness of the atmosphere, under which head Prof. Loomis gives three special cases, *viz.*, remoteness from the ocean, measured in the direction from which the prevalent wind proceeds, areas of high barometric pressure, and high latitudes. This last conclusion does not state that the average rainfall regularly diminishes as we go northwards, the same as the mean temperature; but if the mean annual fall be taken for every 10° of latitude, the important influence on the amount of rainfall is very decided, and is emphatically exhibited in high latitudes. The general table of observations, arranged in order of latitude, shows that for the four stations whose latitude exceeded 71° the mean annual rainfall was 7·44 inches, whilst the paucity of observations of the fall of rain or snow that have been

made during the various Arctic expeditions also demonstrates the fact.

Prof. Loomis has thoroughly investigated the conditions of rainfall in the United States, and from the tables of observations he arrives at the inference that the depression of the barometer accompanying extraordinary rainfalls is not very great, the average pressure at the low centre being 29·63 inches for the part of the United States north of latitude 36°, and the average pressure at the stations of greatest fall being 29·77 inches.

A moderate depression of the barometer is as favourable to great rainfall as an extremely great depression, which would seem to indicate that rainfall has but little connection with barometric depression. It must, however, be remembered that the depression at the centre of a low area depends not merely upon the barometric gradient, but upon the geographical extent of the low area.

The following are some of the conclusions Prof. Loomis arrives at respecting the causes of rainfall in the United States. One of the most common causes of rain is an unstable condition of the atmosphere resulting from an unusually high temperature combined with unusual humidity. Another very common cause of rain frequently associated with this is a cold northerly or westerly wind in the western segment of the low area, and proximity to the ocean or to a large inland sea.

The investigation affords important evidence respecting the influence of rainfall upon areas of low pressure, *viz.*—

No great barometric depression with steep gradients ever occurs without considerable rainfall.

In great rain-storms the barometric pressure generally diminishes while the rainfall increases.

The greatest depression of the barometer generally occurs about twelve hours after the greatest rainfall.

A great fall of rain is favourable to a rapid progress of the centre of least pressure, while a small rainfall is generally attended by a less rapid progress.

It is also noted that some of the characteristics of areas of low pressure with little or no rain are :—

(1). Feeble barometric gradients.
(2). Moderate winds.
(3). Slow changes of barometric pressure.
(4). Slow progressive movement.

Whilst in similar areas of low pressure with excessive rainfalls all these conditions are reversed.

THE STRUGGLE FOR EXISTENCE.—Another matter suggests itself to me. Mr. Wallace in his new and delightful book on "Darwinism," which reawakens one's old enthusiasm, says that many plants live "not where they must, but where they can." The natural habitat does not always appear to be the best. Thus, *Lobelia cardinalis*, so common in our Rhode Island woods, is always found on the brink of running streams, or where these *have* been, or near water. It is in such sense aquatic. But, removed to a garden, it will grow vigorously and multiply astonishingly exposed to full sunlight and in ordinary loam. Indeed, the plants prefer to escape from the beds into the gravelly paths. They will overrun a garden.

Aster Novæ-Angliæ is not one of our most abundant asters, but in a garden it will crowd out all else. The seedlings spring up even in the dry soil loved by *Plantago major*. *Viola pedata*, which grows naturally in sand, will flourish and increase in size by cultivation, becoming as handsome as a pansy. *Corydalis glauca* grows in nature on hot exposed rocks and cliffs; it will grow larger and better, and set seed abundantly, in rich loam.

I could multiply instances of such changed environment where the result was beneficial.—W. WHITMAN BAILEY, of Brown University, Providence, Rhode Island, U.S.A.—*Nature*.

SANDAL-WOOD CARVING IN MYSORE.—The tendency in indigenous Indian industries to localise themselves within narrow circles is well exemplified in the case of the sandal-wood carving of Mysore, an art which is almost entirely confined to a few towns in the north-western corner of the Province and in the adjoining taluks of Bombay. Saugor is the head-quarters of the few families that practise this art, and who have apparently handed it down for generations from father to son; it has never extended beyond this locality. Caste prejudices may have contributed to some extent to the retention of the craft in this particular district, but it is likely that the demand for the articles manufactured was always very limited, and there was no inducement to outsiders to intrude on the demesne of the few who were, so to speak, born and bred to the trade, more especially as the skill and delicacy of touch required could only be acquired by training from early boyhood. Under these circumstances, it is perhaps strange that the art did not die out altogether during the centuries of chronic disturbance under the Pallegar Chiefs; stranger still that it survived the period of Muhammadan supremacy. It is probable that

it was kept alive by the bounty and liberality of a few wealthy local magnates, with a taste for the æsthetic, and although the policy of Hyder Ali and Tippu Sultan aimed at the extirpation of Hindu customs and traditions which invariably find expression in Hindu sculpture and carving, Muhammadan influence never extended to the remoter districts of the Province.

It is not known with any certainty when sandal-wood carving was first introduced in Mysore, but there is a tradition amongst the Gudigars, as the carvers are called, that their ancestors came from Saptakoti, Narway, and other places in the Goa country, and that their original language was Konkani. They believe themselves to be descendants of Kshatriyas; that to escape the wrath of Parsu Rama, in the 6th incarnation of Vishnu, who had vowed to destroy every Kshatriya in the world, they adopted the profession of carvers and "Rath" or car builders, and that ever since they have been following that avocation. It is a fact worthy of notice here that "Chitragars" or painters, toy-makers, workers in lace and followers of other refined arts which administer to the luxury of man, have a similar tradition that they are Kshatriyas. They may not be descended from the old Aryan Kshatriyas, but as it has been usual for every ruling caste or class to assume the name of Kshatriyas, it is not improbable that these artizans once belonged to the dominant class, but were compelled by conquest and subjugation to adopt some profession for their livelihood, and that they took to these fine arts as more in keeping with their previous habits and delicate breeding. This would imply that those Kshatriyas found the trade ready to hand, that they had only to master its technicalities, and that they ousted out in course of time those who originally introduced and pursued it; it gives no hint as to its origin or early development. We must then imagine that the beauty and fragrance of the wood, the ease with which it is wrought, and the wide distribution of the insignificant tree from which it is derived, led in the first instance to its use for domestic articles. The ornamentation of these articles and of the beads, amulets, and articles of personal adornment also probably wrought from the wood in the earliest times, followed in natural sequence, just as the primitive rough-hewn temples of the ancient priests developed in course of time with the growth of the natural artistic instincts of the people into the elaborate and profusely decorated temples of a later period.

In India, as elsewhere, the art instinct of the people first found expression in the decoration of its temples, and when the instinct grew into the desire for the decoration of dwellings or of articles

in ordinary use, the figures, columns, and carvings of the temples were naturally adapted for purposes altogether outside of religion.

So we find that from the beginning the sandal-wood carvers followed the models before them on the walls of their shrines.

Unfortunately, after the architects and sculptors who elaborated the walls of Belgavi and Halebid had disappeared, a period of distinct art-decadence appears to have set in, and has lasted down to the present day; no original artist arose to treat the subjects of the Hindu Pantheon with entire originality, or to effect improvements on the designs of his predecessors, and the wood carvers have slavishly adhered to the same original models with the result of establishing in their work a purely conventional style. In every article that we have seen, unless in the few cases when the copy of a European picture or print has been attempted, there is to be found the same ever-recurring type of Hindu god or demon, of flower and foliage, of tracery and border. There may be diversity in the arrangement or juxtaposition of each conventional part, but the art-impression conveyed on the mind by one carved article, whatever it be, is exactly that conveyed by any other.

In mediæval Christian art we find that pictorial teachings in painting and sculpture were the medium of propagating a knowledge of Christian facts and doctrines and of profane and romantic history. A traditional way of treating those subjects was adhered to by artists of all kinds, and the same mode of treatment was maintained for centuries, yet we find that the mediæval artists were not mere slavish copyists, and though they retained the traditional elements of the subjects and the conventional arrangement of them with curious fidelity, the style of art varied from time to time and the artist told his story in the art vernacular of his own day. He worked in very freely the details of his picture, translating the customs and architecture and other accessories into the fashions of his own time. In ancient Greece the same course had obtained, and it produced the greatest artists and the greatest works of art.

Between these and Eastern art, as embodied at least in Mysore architecture, sculpture, and carving, a parallel may be drawn as regards the adoption of traditional subjects and modes of treatment, but the parallel stops abruptly when we come to variety in expression and to modifications, or improvements of the original examples. Centuries ago in Mysore a few beautiful types were created; for a time perhaps slight variations on these were introduced; but stagnation soon followed, and artists in stone and wood degenerated rapidly into mere copyists, and copyists pure and simple they have remained to the present day.

When we come to the "technique" of his art, we find that the tools of the sandal-wood carver are simple and rude, all locally manufactured: his modes of working primitive in the extreme. He works exactly as his forefathers worked, his method and means are precisely those of centuries ago. Although the number of tools employed is considerable, many sizes being required at the various stages of each operation, they may be classified simply as the chisel, the curved chisel, the graver, the gouge, the mallet; in addition to which the ordinary carpenter's drill, square and lines are employed. The carver having selected a strong-scented and fine-grained log, which he himself saws into slabs of ½ to ¾ inch thick, cuts and planes it into panels of the sizes required for the article to be manufactured. He next sketches in pencil the outline of the design on the wood itself, when the design is not very elaborate; when intricate carvings are required, the drawing is made on thin paper which is pasted on to the panel. He then proceeds to cut and engrave the pattern into the wood, working out the outlines roughly at first, following up the first rough stage by a finer one with a finer tool, until by degrees the bold relief and deep undercutting are patiently attained, and the finishing touch given with the most delicate of his chisels. It may seem absurd, more especially when we examine closely the best samples of his work, but it is a fact that the net result to the first class carver of all his patience and skill is for a carved slab, at the ruling prices, the equivalent of a wage of 1½ rupees a day. The apprentice, always a member of the family, begins by simply watching continuously and with close attention the various stages in the work of the master, then he is put to practice on pieces of waste wood, after which he is promoted to the actual carving of inferior articles. He never actually assists the master, who never even guides his boyish hand or shows him how to select and handle the tools; he learns simply from patient watching and imitation.

Such is briefly the history and description of this interesting industrial art, in which Mysore claims a distinct pre-eminence. But what is to be done to raise the carver's work, hitherto confined to mere copyism, to the true level of an art-manufacture? Selected specimens of their work have recently been exhibited at the Calcutta and Indian and Colonial Exhibitions. These have been much admired and a stimulus to the demand for sandal-wood articles may be thereby created. The number of good carvers is, however, very limited; a few of them have recently migrated to Cashmere to take service under the Maharaja of that Province,

and some have obtained permanent employ under the Maharaja of Mysore, who takes an enlightened interest in their work, which it is his desire to foster and encourage. An enhanced demand is more likely to result in a deterioration of workmanship than in any advancement in style and design ; we will have quantity, not quality. The present families of carvers being so few, and apprenticeship having to commence at a very early age, in order that the necessary delicacy of touch and manipulative skill may be acquired, it would seem impossible to expect any extension of the best class of work or the attainment of any originality or variety in style without the direct intervention of the State. What shape State help should take is the problem. There is no Art-School in Mysore, nor can recourse well be had to the Art-Schools of the Presidency towns, for what would be gained as regards designing by youths attending these institutions would be lost to them as regards the essential manual skill acquired by early and constant practice. The distribution amongst the families of carvers, of suitable modern designs and patterns, periodical local exhibitions, and money prizes may do something ; but it is doubtful whether anything short of the endowment of a school to be devoted entirely to this purpose, with the best of the carvers selected as masters and with liberal scholarships, will effect the revival of what appears to be a fast-decaying industry.—*Indian Engineering.*

Creosoting Timber.—At the January meeting of Civil Engineers of Ireland, Mr. J. P. Griffith read a note on creosoting wood-paving sets. In it, tar acids are held to be comparatively useless ; the exclusive use of heavy oils is advocated. Mr. Griffith endorses Boulton's modification of Bethel's process. It appears hopeless to expect any very good results from wood-paving capable of absorbing large quantities of water. It is nevertheless contended that efficient creosoting is of benefit, inasmuch as it removes a certain amount of moisture from the timber ; it coagulates albumen in it ; it fills the pores and fibrous passages with heavy creosote, which is not soluble in water or volatile at ordinary temperatures, and which, by its antiseptic properties, prevents decay caused by the fermentation or putrefaction of the organic constituents of the timber ; it renders wooden set practically constant in volume at all ordinary temperatures and in all weathers. Experiment goes to show that the coagulation of the albumen and the saturation of the wood with creosote will also strengthen the timber to support heavy loads, and assist in resisting the distortion or crushing of the fibres.—*Indian Engineering.*

DUNG AS MANURE.—The value of dung for the root-crop may be readily proved from the experiments undertaken at Rothamsted, and by results obtained by the Cirencester Chamber of Agriculture. The value of dung has been chiefly appraised upon its chemical ingredients, excluding carbon and moisture as useless, or, at best, as of little value; but M. Deherain views the carbon as of a much higher importance than is usually attached to it. My own view of the importance of farm-yard dung is based upon a large number of qualities, which may be grouped as follows:—

1*st.* Its general composition, due to the fact that it contains all the necessary constituents of plant food.

2*nd.* The fact that the food-materials are inorganic combination, and therefore gradually liberated, in a fresh and easily appropriated state, for the use of growing plants.

3*rd.* That it is a source of nitric acid.

4*th.* That its nitrification is most active at the period of greatest plant-growth, and is arrested in cold weather.

5*th.* That it is less liable to wash through the soil than artificial nitrogenous manures.

6*th.* That it is durable and permanently enriches a soil.

7*th.* That it is cheaply produced on farms where stock-feeding is profitably carried on.

8*th.* That it acts in all climates.

9*th.* That it acts on all soils.

10*th.* That it acts on all crops, even upon leguminous plants, which are very difficult to touch with any artificial combination of fertilizers.

So excellent is dung as a manure that when used in quantity and applied frequently no other manure can add to its effect. It has indeed been often seen that on dunged land application even of such an excellent manure as superphosphate to a turnip crop has not resulted in any increase, and often in a positive decrease of the crop. We do not, however, believe that in such cases the superphosphate has been injurious. Such a result must be rather viewed as negative, and as brought out by the luxuriance of the crop on the parts not treated with superphosphate, than in any injury wrought by this fertilizer when it was applied. The weakest point in dung seems to be that it cannot be obtained in sufficient quantity for the requirements of a large farm. It may also be urged as an objection that when soils are deficient in special ingredients, as in phosphates, lime, or potash, a shorter and more direct means of remedying the evil is found in applications of phosphates, lime, or kainit. It would be unpardonable to deny the

great value to farmers of artificial manures. Turnip husbandry could not be carried on without them, and corn crops are immediately benefited by applications of nitrate of soda. Farm-yard manure has of late years been attacked as an expensive and wasteful manure, and if this is true, the whole superstructure of the relation of live stock to the fertility of land is destroyed at a time when live stock is acknowledged to be the mainstay of the farmer. M. Deherain's observations therefore come in as a useful addition to our views as to the value of dung, the tendency of his remarks being to explain the peculiar importance which farmers attach to dung as the principal source of fertility in land. They are as follows :—

1. A soil exhausted by cultivation is especially impoverished in organic matter, which results from the diminution of carbon that is met within it.

2. That this diminution in the organic nature is particularly fatal to the resulting crops of beet-root and leguminose, but less to the cereals, especially oats.

3. That this diminution in the crops cannot be attributed to secondary causes, such as the loss of power to retain water, to produce nitrates or carbonic acid.

4. That in effect cultivating two beet-roots comparatively one in a soil rich in *organic* matter, the other in a poor soil but well provided with nitrates, phosphates and potash, the results have been in the proportions of 4·3 to 1.

5. That it appears probable that the organic matter forms part of the nutriment of beet-root conjointly with the nitrates, phosphates, &c., and that it is owing to its absence in lands impoverished by cultivation without dung, that it is necessary to attribute the smallness of the yield that they furnish, when even all the other elements are found in abundance.

On the nitrogen question especially the experiments have been exceedingly striking and resuscitate Liebig's views.—PROFESSOR WRIGHTSON *in Agricultural Gazette.*

THE INDIA-RUBBER MARKET.—Advices from home state that the rubber market in Brazil is liable to give out entirely, as the supply on hand is very small. Rubber has advanced from 2,200 to 2,400 reis. The stock is 5,000,000 lbs. less than it was a year ago, showing that the consumption of rubber is exceeding the production. A good prospect for Burma and Malaya.—*Indian Engineering.*

MYSORE TEAK.—This wood, like Malabar teak, is several pounds heavier per cubic foot than Rangoon teak, and is found far more durable for ship-building purposes. It is not so long in the grain and consequently more difficult to work than Moulmein timber. Trees of enormous size are to be found in Karkankota and Begur jungles, but these giants of the forest are not cut down, as the great thickness of the logs (10 feet in diameter) would prevent their removal. Godavari teak is inferior to both the Mysore and Burma.—*Indian Engineering.*

POPULAR BELIEF IN THE AVENGING HABITS OF SNAKES.—A recent number of the *China Review* (Vol. xvii., No. 3) contains a paper by Dr. Macgowan on the alleged avenging habits of the cobra in Indian and Chinese folk-lore. The belief in India is that a wounded cobra which escapes will sooner or later revenge itself on the man who has caused the injury, wherever he may go or whatever he may do. Dr. Macgowan says that this belief is prevalent in Indo-China and China as well as in India. But in China there is also a strong prejudice against killing the cobra, lest its spirit should haunt the slayer ever after. Cobras, therefore, are shunned rather than pursued and attacked. Popular stories of the dire consequences of slaying them keep up the superstition: a high official who had killed one died soon afterwards of some mysterious disease, and the death is attributed to the slain snake; again, the spirit of the snake enters into possession of its slayer, and employs the vocal organs of the latter in uttering imprecations on himself until death mercifully removes him. Dr. Macgowan gives a large number of stories of this character. A number of others refer to the retribution on snake-killers after their own deaths. Gratitude, as well as vindictiveness, is ascribed to snakes, of which some characteristic stories are given. In conclusion, Dr. Macgowan observes that the recently established vernacular press in China furnishes inexhaustible stores of folk-lore. "Paragraphs describing popular superstitions, impossible occurrences, monstrosities and so forth, constitute a great portion of their matter." In regard to snakes, the marvel is that any are killed at all in China, so many dreadful punishments are supposed to overtake their destroyers; and, indeed, it is considered a work meriting favour here and hereafter to purchase captured snakes and liberate them. Nevertheless, poisonous snakes are not numerous in China, probably because their presence is inconvenient to Chinese farmers, and they are therefore destroyed, folk-lore notwithstanding.—*Nature.*

YJ. Extracts from Official Gazettes.

1.—Gazette of India—

No. 131.—*The 17th March, 1890.*—*Mr. A. Smythies*, Deputy Conservator of Forests, 3rd grade, North-Western Provinces and Oudh, and Officiating Instructor at the Forest School, Dehra Dún, is granted furlough for seven months, under Article 340(*b*) of the Civil Service Regulations, with effect from the 4th April, 1890, or any subsequent date on which he may avail himself of the leave.

No. 26-33.—*The 1st April, 1890.*—The Hon'ble *W. C. Benett*, Secretary to the Government of the North-Western Provinces and Oudh, is appointed to officiate as Secretary to the Government of India in the Revenue and Agricultural Department during the absence of *Sir E. C. Buck*, Kt., on furlough.

Mr. Benett assumed charge of the office on the forenoon of the 1st April, 1890.

No. 260.—*The 11th April, 1890.*—The following temporary appointments and promotions are made during the absence on furlough of *Lieutenant-Colonel F. Bailey, R.E.*, Conservator of Forests, 2nd (Officiating 1st) grade, School Circle, North-Western Provinces and Oudh, and Director of the Forest School at Dehra Dún, with effect from 24th March, 1890, and until further orders :—

Mr. G. Mann, Conservator, 2nd grade, Assam, to officiate in the 1st grade.

Mr. C. Bagshawe, Conservator, 3rd (Officiating 2nd) grade, Central Circle, North-Western Provinces and Oudh, to be Conservator of the School Circle, and Director of the Forest School.

Mr. R. H. C. Whittall, Conservator, 3rd grade, Punjab, who in Notification No. 79 F.-C. of 14th February last was appointed to officiate in the 2nd grade *vice Mr. Home*, on privilege leave, to continue to officiate in the 2nd grade.

Mr. S. Eardley-Wilmot, Deputy Conservator, 3rd (Officiating 2nd) grade, North-Western Provinces and Oudh, to officiate in the 3rd grade of Conservators and to hold charge of the Central Circle, with effect from the date on which he assumes charge of that Circle from *Mr. Bagshawe*.

No. 304.—*The 24th April, 1890.*—*Mr. F. B. Dickinson*, Deputy Conservator of Forests, 2nd grade, Central Provinces, officiated in the 1st grade of Deputy Conservators from the 21st January to the 31st March, 1890, both dates inclusive.

No. 306.—The following reversions took effect from 30th March, 1890, consequent on the return from privilege leave of *Mr. A. L. Home*, Conservator of Forests, 3rd (Officiating 2nd) grade, Bengal :—

Mr. H. H. Davis, Officiating Conservator, 3rd grade, Bengal, to Deputy Conservator, 1st grade.

Mr. J. T. Jellicoe, Deputy Conservator, Officiating 1st grade, Assam, to Deputy Conservator, 2nd grade.

No. 307.—*The 5th May, 1890.*—Consequent on the departure on furlough of *Mr. A. Smythies*, Officiating Instructor at the Forest School, Dehra Dún, *Mr. E. E. Fernandez*, Deputy Director of the Forest School, is appointed to hold charge of the Office of Instructor at the School, in addition to his own duties, with effect from the 3rd April, 1890, and until further orders.

2.—MADRAS GAZETTE—

The 8th March, 1890.—*Mr. J. G. F. Marshall*, Sub-Assistant Conservator, 2nd grade, on probation, is confirmed in that grade from 1st instant.

Mr. C. J. Woutersz, Probationary Sub-Assistant Conservator, Salem District, to be Sub-Assistant Conservator, 2nd grade, with effect from 2nd June, 1889.

Mr. C. P. Howell, Sub-Assistant Conservator, Acting 1st grade, from the South Arcot District to Trichinopoly, for special duty until further orders.

Mr. C. J. Woutersz, Sub-Assistant Conservator, 2nd grade, from Salem to South Arcot District.

Of the officers who appeared on the 17th January last for the Departmental Test prescribed in para. 56 of the Madras Forest Code, the following have passed :—

C. Subrahmanya Aiyar, Ranger, 5th grade, on probation, (*a* and *b*) Code, Act and Rules.

S. P. Kulasegaram Chetty, Forester, 3rd grade, (*a* and *b*) Code, Act and Rules.

Mr. E. Monisse, Forester, 3rd grade, (*a* and *b*) Code, Act and Rules.

Mr. J. W. Ryan, Forester, Acting 1st grade, (*a* and *b*) Code, Act and Rules.

Mr. A. B. Meyers, Forester, 3rd grade, (*a* to *e*) Code, Act and Rules, and Forestry.

The previous sanction of Government and the Board of Revenue having been obtained, the following promotions in the Staff of the Northern Circle are herewith ordered :—

M. R. Ry. T. M. Nallasawmy Naidu Garu, Sub-Assistant Conservator, 2nd grade, to be Sub-Assistant Conservator, 1st grade, from 25th November, 1889.

Mr. H. H. Ward, Forest Ranger, 1st grade, to be Sub-Assistant Conservator, 2nd grade, from 25th November, 1889.

M. R. Ry. V. Alwar Chetty Garu, Sub-Assistant Conservator, 2nd grade, to be Sub-Assistant Conservator, 1st grade, from 4th December, 1889.

Mr. T. G. A. Gaudoin, Forest Ranger, 1st grade, to be Sub-Assistant Conservator, 2nd grade, from 4th December, 1889.

No. 117.—*The 11th March, 1890.*—*Culesa Subba Row*, late Forester, Vayalpad Taluk, Cuddapah District, having been convicted of abetment of theft of timber from Government forests under Sec-

tions 109 and 379 of the Indian Penal Code, is hereby declared ineligible for further employment in the public service.

The 13th March, 1890.—In consequence of the promotion of *Mr. H. H. Ward*, to be a Sub-Assistant Conservator of Forests from the 25th June, 1889, the following promotions are ordered in the Staff of Forest Rangers of the Northern Circle with effect from that date :—

Mr. W. R. Newman, Forest Ranger, 2nd class, to be Forest Ranger, 1st class, permanent.

V. P. Ramalingam Pillay, Forest Ranger, 3rd class, to be Forest Ranger, 2nd class, permanent.

R. Sundram Pillay, Forest Ranger, 4th class, to be Forest Ranger, 3rd class, permanent.

P. Ananda Row, Forest Ranger, 5th class, to be Forest Ranger, 4th class, permanent.

In consequence of the promotion of *Mr. T. G. A. Gaudoin* to be a Sub-Assistant Conservator of Forests, from the 4th December, 1889, the following promotions are ordered in the Staff of Forest Rangers of the Northern Circle with effect from that date :—

V. P. Ramalingam Pillay, Forest Ranger, 2nd class, to be Forest Ranger, 1st class, permanent.

Mr. H. J. McLaughlin, Forest Ranger, 3rd class, to be Forest Ranger, 2nd class, permanent.

P. Ananda Row, Forest Ranger, 4th class, to be Forest Ranger, 3rd class, permanent.

A. Eggia Sastri, Forest Ranger, 5th class, to be Forest Ranger, 4th class, permanent.

C. Venkatramaniah, Forester, 1st grade, and Acting Forest Ranger, 5th class, is confirmed in the latter appointment from 7th February, 1890.

C. M. Parthasarathy Naidu, Head Clerk, District Forest Office, Bellary, is appointed as Forest Ranger, 5th class, on probation, from 1st March, 1890, and posted to the Kistna District.

The following transfers are ordered in the Staff of the Northern Circle :—

Mr. T. N. Hearsey, Sub-Assistant Conservator of Forests, 2nd grade, from Kurnool to Godavari.

Mr. H. Stafford, Sub-Assistant Conservator of Forests, 2nd grade, from Godavari to Bellary.

Mr. M. H. Tweedie, Forest Ranger, 3rd grade, from Kistna to Kurnool.

Mr. W. R. McCay, Forest Ranger, 5th grade, from Anantapur to Cuddapah.

M. Kothandarama Mudaliar, Forest Ranger, 5th grade, from Bellary to Godavari.

The 14th March, 1890.—In the Notification, dated 8th March, 1890, regarding the promotion of *M. R. Ry. T. M. Nallasawmy Naidu Garu* and others, published in the *Fort St. George Gazette*, dated 11th March, 1890, Part II., page 386—

For—" From 25th November, 1889."

Read—" From 25th June, 1889."

No. 112.—*Mr. F. D'A. Vincent*, Deputy Conservator of Forests, Madras, has been granted by the Right Honourable the Secretary of

State an extension of leave for two months on medical certificate and four months' extraordinary leave on medical certificate without pay.

No. 120.—*The 18th March, 1890.—Messrs. Claude Du Pre Thornton* and *Arthur Bashe Jackson*, Trained Forest officers appointed by Her Majesty's Secretary of State, having reported their arrival in Madras on the forenoon of the 28th December, 1889, are brought on the strength of the Madras Forest Establishment as Assistant Conservators, 3rd grade, from that date, and are posted to the Tinnevelly and Nellore Districts respectively.

No. 110.—*Mr. J. S. Gamble*, Conservator of Forests, Northern Circle, is granted special leave for six months on urgent private affairs from or after the 1st April, 1890, under Article 348 of the Civil Service Regulations.

No. 130.—*The 20th March, 1890.—Mr. P. M. Lushington*, Acting Assistant Conservator of Forests, 2nd grade, is confirmed in that grade with effect from the 15th January, 1890.

The 21st March, 1890.—The two months' leave granted to Forest Ranger *M. Shumsuddin Sahib* and notified at page 44, Part II. of the *Fort St. George Gazette*, dated 14th January, 1890, is extended by one month, *i.e.*, up to 24th April, 1890.

Mr. E. C. M. Mascarenhas, Forest Ranger, privilege leave under Article 291 of the Civil Service Regulations for two months from 15th April, 1890.

No. 125.—*The 24th March, 1890.—Mr. A. W. Peet*, Deputy Conservator of Forests, 1st grade, to act as Conservator of Forests, Northern Circle, during the absence of *Mr. J. S. Gamble* on leave, or until further orders.

The following confirmations are ordered in the Staff of the Southern Circle :—

Mr. S. C. Moss., Ranger, 2nd class, and Acting Sub-Assistant Conservator, 2nd class, sub. *pro tem.*, to be Sub-Assistant Conservator, 2nd class.

Mr. W. P. Rego, Ranger, 3rd class, Acting sub. *pro tem.*, 2nd class, to be Ranger, 2nd class.

Mr. N. M. Rego, Ranger, 4th class, Acting sub. *pro tem.*, 3rd class, to be Ranger, 3rd class.

M. Jambunadha Shastri, Ranger, 5th class, Acting sub. *pro tem.*, 4th class, to be Ranger, 4th class.

Mr. H. Kelly, Ranger, 5th class, on probation, to be Ranger, 5th class.

C. Subrahmanya Iyer, Ranger, 5th class, on probation, to be Ranger, 5th class.

The 25th March, 1890.—The following promotions are ordered in the Staff of the Northern Circle from 1st April, 1890 :—

L. Hanumanthulu, Forester, 1st grade, to be Forest Ranger, 5th class.

S. Arokiasawmi Pillai, Forester, 1st grade, to be Forest Ranger, 5th class, *vice Mr. J. M. Payrie* and *C. V. Parthasarathy Naidu* reverted to the class of "Forester."

The 28th March, 1890.—Mr. R. S. Bower, Forest Ranger, 4th class, from North Arcot to Salem.

Mr. J. S. Grogan, Forest Ranger, 5th class, from Tinnevelly to Salem.

Mr. A. M. Clay, Forester, 4th class, North Arcot, to act as Ranger, 5th class, from 1st March, 1890, during the absence of Ranger *Shamsuddin Sahib*, on leave, or until further orders.

In consequence of the absence of Forest Ranger, *Mr. M. H. Tweedie*, on sick leave for six months from 27th March, 1890, the following acting promotions are ordered and will take effect from the same date:—

A. Eggia Sastry, Forest Ranger, 4th class, promoted to Acting Forest Ranger, 3rd class.

N. Nagarazu, Forest Ranger, 5th class, promoted to Acting Forest Ranger, 4th class.

P. R. Ruthnasawmy Pillay, Forester, 1st grade, promoted to Acting Forest Ranger, 5th class.

P. R. Ruthnasawmy Pillay, Forester, 1st grade, is transferred from Nellore to Nilgiris, but will act as Forest Ranger, 5th class, in the Kurnool District during the absence of Forest Ranger, *Mr. M. H. Tweedie* on leave, or until further orders.

The 1st April, 1890.—The promotion of *L. Hanumanthulu*, ordered in Office order No. 81 of 1889-90, is hereby cancelled.

The 11th April, 1890.—In the Notification regarding the promotion of Forester, *Mr. Clay*, published at page 504, Part II. of the *Fort St. George Gazette*, dated 1st April, 1890—

For—"*Mr. A. M. Clay*, Forester, 4th class," &c.

Read—"*Mr. A. M. Clay*, Forester, 1st class," &c.

Mr. M. H. Tweedie, Probationary Forest Ranger, 3rd grade, Kurnool District, is declared to have passed the Surveying and Levelling Tests prescribed in para. 55 of the Forest Department Code and is confirmed in his appointment with effect from 20th March, 1890.

No. 154.—*Mr. A. B. Jackson*, Assistant Conservator of Forests, transferred from Nellore to Cuddapah.

No. 152.—*The 12th April, 1890.*—*Mr. W. C. Hayne*, District Forest Officer, Trichinopoly, privilege leave for three months, from such date as he may avail himself of it, under Article 291 of the Civil Service Regulations.

No. 153.—*Mr. C. P. Howell*, Sub-Assistant Conservator of Forests, 2nd grade, to act as District Forest Officer, Trichinopoly, during the absence of *Mr. W. C. Hayne*, on leave.

The 15th April, 1890.—In the Office order of the Conservator of Forests, Northern Circle, No. 1, dated 1st April, 1890, published at page 534, Part II., of *Fort St. George Gazette*, dated 15th April, 1890—

For—"Office Order No. 81 of 1889-90."

Read—"Office Order No. 95 of 1889-90."

The 21st April, 1890.—Rangers, *Messrs Thompson* and *M. Rama Rao*, on return from the Forest School, Dehra Dún, are posted, on arrival, to the South and North Malabar Divisions respectively, the latter as a temporary arrangement.

The 22nd April, 1890.—*To Mr. J. S. Grogan*, Forest Ranger, 5th class, Tinnevelly (since transferred to Salem), leave on medical certificate for one month from 5th March, 1890, under Article 369 of the Civil Service Regulations.

G. Arulanandam Pillai, Forester, 1st class, Tinnevelly, to act as Ranger, 5th class, during *Mr. Grogan's* absence on leave.

No. 172.—*The 24th April, 1890.*—*Mr. G. Homfray*, Assistant Conservator of Forests, 1st grade, to act as Examiner of Forest Accounts during the absence of *Mr. C. G. Douglas* on leave.

No. 173.—*Mr. H. H. Ward*, Sub-Assistant Conservator of Forests, 2nd grade, to act as District Forest Officer, Kurnool, during the absence of *Mr. G. Homfray* on other duty.

No. 168.—*The 25th April, 1890.*—*Mr. C. G. Douglas*, Examiner of Forest Accounts, is granted privilege leave for three months from 1st May, 1890, under Article 291 of the Civil Service Regulations.

The 28th April, 1890.—To Ranger *Mr. Thompson*, privilege leave under Article 291 of the Civil Service Regulations, for two months from 21st April, 1890.

To *N. Subbaiyar*, Forest Ranger, 3rd class, Salem, under Article 369 of the Civil Service Regulations, leave on medical certificate for three months from date of relief.

3.—Bombay Gazette—

The 15th March, 1890.—*Mr. E. G. Oliver*, Assistant Conservator of Forests, delivered over charge of the Divisional Forest Office, Working Plans Branch, Party No. II., Kánara, to his Sub-Assistant, *Mr. N. D. Satarawala* on the 11th instant, afternoon.

No. 2437.—*The 8th April, 1890.*—*Mr. W. S. Hexton*, Deputy Conservator of Forests, 1st grade, is allowed an extension by four days of the privilege leave of absence for two months and fifteen days granted to him in Government Notification No. 749, dated 29th January, 1890.

Messrs. N. D. Satarawala, Sub-Assistant Conservator, and *E. G. Oliver*, Assistant Conservator, respectively handed over and received charge of the Divisional Forest Office, Working Plans Branch Party No. II., Kánara, on the 8th instant, after office hours.

Mr. W. A. Talbot, Deputy Conservator of Forests, who was granted three months' privilege leave by Government Resolution, Revenue Department, No. 1732 of the 5th March, 1890, delivered over charge of the Northern Divisional Office, Kánara, to *Mr. Murray*, Deputy Conservator, on the 10th instant, after office hours.

No. 2586.—*The 15th April, 1890.*—*Mr. G. A. Hight*, Deputy Conservator of Forests, 2nd grade, and Divisional Forest Officer, Dhárwár, is allowed privilege leave of absence for one month from 20th April, 1890, or from such subsequent date as he may avail himself of it.

No. 2830.—*The 25th April, 1890.*—*Mr. A. T. Shuttleworth*, Conservator of Forests, N. C., is granted privilege leave of absence for three months from 1st May, 1890, or such subsequent date as he may avail himself of it.

No. 2923.—His Excellency the Governor in Council is pleased to appoint—

Mr. R. C. Wroughton to act as Conservator of Forests, N. C.,

during the absence of *Mr. A. T. Shuttleworth*, or pending further orders;

Mr. W. G. Betham to act as Divisional Forest Officer, Poona, during the absence of *Mr. Wroughton*, or pending further orders; and

Mr. W. A. Wallinger to act as Divisional Forest Officer Násik, during the absence of *Mr. Betham*, or pending further orders.

4.—Calcutta Gazette—

The 1st April, 1890.—Examination leave for one month, under the provisions of Section 57 of the Forest Department Code, is granted to *Mr. H. H. Haines*, Assistant Conservator of Forests, with effect from the date on which he may avail himself of it.

Mr. W. H. Lovegrove, Assistant Conservator, attached to the Direction Division, is posted to the charge of the Kurseong Sub-division, Darjeeling Forest Division, during the absence of *Mr. Haines*, or until further orders.

The 8th April, 1890.—In continuation of the Notification, dated the 10th January, 1890, promoting *Mr. H. D. D. French* to the 2nd grade of Assistant Conservators of Forests, with effect from the 11th November, 1889, *Mr. French* is appointed to officiate in the 1st grade of Assistant Conservators of Forests until further orders, with effect from that date, to fill an existing vacancy.

So much of the notification, dated the 18th February, 1890, as relates to *Mr. French*, is hereby cancelled.

The 18th April, 1890.—Consequent on the reversion of *Mr. H. H. Davis*, Officiating Conservator of Forests, 3rd grade, to his substantive appointment of Deputy Conservator of Forests, 1st grade, with effect from the 30th March, 1890, on the return from the three months' privilege leave of *Mr. A. L. Home*, Conservator of Forests, Bengal, of which he availed himself with effect from the 30th December, 1889, (*vide* Notification, dated the 31st idem), the following reversion is ordered with effect from the 30th March, 1890:—

Mr. G. A. Richardson, Officiating Deputy Conservator of Forests, 2nd grade, to the 3rd grade of Deputy Conservator of Forests.

The 21st April, 1890.—*Mr. J. C. Mendes*, Sub-Assistant Conservator of Forests, having reported his return on the 10th March, 1890, from the Central Provinces, to which he was transferred temporarily in the Notification, dated the 22nd March, 1889, assumed charge of the Palamow Sub-division of the Chota Nagpur Forest Division on the 21st idem.

5.—Assam Gazette—

No. 1633.—*The 7th March, 1890.*—*Mr. D. P. Copeland*, Assistant Conservator, 1st grade, and Officiating Deputy Conservator, 4th grade, is confirmed in that grade, *vice Mr. F. S. Barker*, transferred to the Central Provinces.

No. 1830.—*The 15th March, 1890.*—*Mr. T. J. Campbell*, Assistant Conservator of Forests, 1st grade, is appointed to officiate in the

4th grade of Deputy Conservator of Forests, *vice Mr. C. G D. Fordyce*, on leave

No. 1831.—*Mr. H. G. Young*, Officiating Assistant Conservator of Forests, 1st grade, is confirmed in that grade, *vice Mr D. P. Copeland*, promoted to the 4th grade of Deputy Conservators of Forests.

No. 2502 —*The 10th April, 1890.—Mr. T. J. Campbell*, Assistant Conservator of Forests, on return from privilege leave, received charge of the Gáro Hills Forest Division from *Mr. D. P. Copeland*, Deputy Conservator of Forests, on the forenoon of the 7th March, 1890.

6.—NORTH-WESTERN PROVINCES AND OUDH GAZETTE—

No. $\frac{976}{\text{II-845A-62}}$.—*The 14th March, 1890.—Lieutenant-Colonel F. Bailey, R.E*, Conservator of Forests, North-Western Provinces and Oudh, School Circle, furlough for two years, with effect from the 11th March, 1890, or subsequent date.

No. $\frac{983}{\text{II-227A-24}}$.—*Mr. N. Hearle*, Deputy Conservator of Forests, 3rd grade, was employed on special duty in the Ganges Forest Division of the Central Circle from the afternoon of the 23rd November to the afternoon of the 6th December, 1889.

No. $\frac{1792}{\text{II-845A-73}}$.—*The 1st April, 1890.—Mr. J M. Blanchfield*, Sub-Assistant Conservator of Forests, to hold charge of the Garhwál Division, in addition to his own duties, from such date as he may take over charge from *Mr. S. E.-Wilmot*, Deputy Conservator of Forests, and until further orders.

No. $\frac{1803}{\text{II-851-68}}$.—*The 22nd April, 1890.—Mr. A. P. Grenfell*, who has been appointed to the Forest Department by the Right Hon'ble the Secretary of State for India, to be an Assistant Conservator of Forests, 3rd grade, and to be posted to the Jaunsar Division of the School Circle, with effect from the date of taking over charge.

No. $\frac{1882}{\text{II-112B-1}}$.—*The 28th April, 1890.—Mr. N. Hearle*, Deputy Conservator of Forests, in charge of the Ganges Division, to the charge of the Dehra Dún Division.

No. $\frac{1883}{\text{II-112B-2}}$.—*Mr. L. Mercer*, Officiating Deputy Conservator of Forests, in charge of the Dehra Dún Division, to the charge of the Saháranpur Division.

No. $\frac{1884}{\text{II-112B-3}}$.—*Mr. B. B. Osmaston*, Assistant Conservator of Forests, in charge of the Saháranpur Division, to the charge of the Ganges Division.

No. $\frac{1990.}{\text{II-99B-3}}$.—*The 2nd May, 1890.—Mr. W. Shakespear*, Deputy Conservator of Forests, 3rd grade, whose services have been placed at the disposal of this Government by the Government of the Punjab, to hold charge of the Pilibhít Division and Bhira Sub-division of the Oudh Circle.

7.—PUNJAB GAZETTE—

No. 100.—*The 10th March, 1890.*—*Mr. G. S. Hart*, Assistant Conservator of Forests, Direction Division, on being recalled from the privilege leave granted him in *Punjab Government* Notification No. 61, dated 11th February, 1890, reported his return to duty on the forenoon of 14th February, 1890.

The unexpired portion of *Mr. Hart's* privilege leave is hereby cancelled.

No. 104.—*The 12th March, 1890.*—*Mr. A. V Monro*, Assistant Conservator of Forests, on relief by *Mr. A. E. Wild*, Deputy Conservator of Forests, of the charge of the Hazára Forest Division, is attached to the Lahore Forest Division, with effect from the forenoon of the 15th February, 1890.

No. 107.—In substitution of *Punjab Government Gazette* Notification No. 468, dated 17th December, 1889, the following temporary promotions shall take place, with effect from the 11th of November, 1889, *vice Mr. A. E. Wild*, Deputy Conservator of Forests, 1st grade, proceeding on privilege leave :—

Mr. W. Shakespear to act as Deputy Conservator, 2nd grade.

Mr. E. A. Down to act as Deputy Conservator, 3rd grade.

Mr. A. L. McIntire to act as Deputy Conservator, 4th grade.

No. 110.—In substitution for *Punjab Government Gazette* Notification No. 466, dated 17th December, 1889, the following reversions are made with effect from the forenoon of the 13th of November, 1889, consequent on the return from furlough of *Mr. J. C. McDonell*, Deputy Conservator of Forests, 1st grade :—

Mr. W. Shakespear to Deputy Conservator, 3rd grade.

Mr. E. A. Down to Deputy Conservator, 4th grade.

Mr. A. L. McIntire to Assistant Conservator, 1st grade.

No. 123.—*The 22nd March, 1890.*—In consequence of *Mr. C. F. Rossiter's* reversion to the grade of Sub-Assistant Conservator, Officiating Sub-Assistant Conservator of Forests, *Faizdin* reverts to Forest Ranger, 2nd grade, with effect from 24th December, 1889.

No. 129.—*The 26th March, 1890.*—*Messrs. W. Shakespear*, Deputy Conservator of Forests, and *A. V. Monro*, Assistant Conservator of Forests, respectively made over and assumed charge of the Lahore Forest Division on the afternoon of 15th March, 1890.

No. 147.—*The 2nd April, 1890.*—Punjab Government Notifications Nos. 38 and 40, dated 28th January, 1890, regarding reversion and temporary promotion of *Mr. G. S. Hart*, are hereby cancelled.

No. 149.—With reference to Government of India Notification No. 16 F.-C., dated 29th November, 1889, and with effect from the date on which *Mr. Reynolds* proceeded on furlough, the following temporary promotions will take place :—

Mr. W. Shakespear to act as Deputy Conservator, 2nd grade.

Mr. E. A. Down to act as Deputy Conservator, 3rd grade.

Mr. A. L. McIntire to act as Deputy Conservator, 4th grade.

No. 150.—Consequent on the return from privilege leave of *Mr. A. E. Wild*, Deputy Conservator of Forests, 1st grade, the following reversions shall have effect from the forenoon of the 11th February, 1890 :—

Mr. W. Shakespear to Deputy Conservator, 3rd grade.
Mr. E. A. Down to Deputy Conservator, 4th grade.
Mr. A. L. McIntire to Assistant Conservator, 1st grade.

No. 151.—Consequent on the departure of *Mr. E. A. Down*, Deputy Conservator of Forests, on the leave granted to him in Punjab Government No. 28, dated 25th January, 1890, the following temporary promotion to take place with effect from the 16th February, 1890, or until further orders:—

Mr. A. L. McIntire, to act as Deputy Conservator, 4th grade.

No. 153.—With reference to Punjab Government Notification No. 91, dated 5th March, 1890, it is hereby notified that *Lála Jowála Parshád*, Sub-Assistant Conservator of Forests, availed himself of the leave therein granted with effect from the forenoon of 16th March, 1890.

No. 163.—*The 8th April, 1890.*—In consequence of *Lála Jowála Parshád's* departure on three months' privilege leave, Ranger *Fazldín* to officiate as Sub-Assistant Conservator of Forests with effect from the forenoon of 16th March, 1890.

No. 177.—*The 15th April, 1890.*—Consequent on the deputation to the Patiála State of *Mr. G. G. Minniken*, Officiating Deputy Conservator, 2nd grade, the following temporary and sub. *pro tempore* promotions to take place with effect from the forenoon of the 19th March, 1890, and until further orders:—

Mr. W. Shakespear to Deputy Conservator, 2nd grade.
Mr. E. A. Down to Deputy Conservator, 3rd grade, sub. *pro tem.*
Mr. J. H. Lace, Officiating Deputy Conservator, 4th grade, confirmed in that grade sub. *pro tem.*
Mr. R. J. P. Pinder, sub. *pro tem.*, Assistant Conservator, 1st grade, to officiate as Deputy Conservator, 4th grade.
Mr. E. R. Murray, Officiating Assistant Conservator, 1st grade, confirmed in that grade sub. *pro tem.*

No. 180.—The furlough for one year granted to *Mr. L. G. Smith*, Deputy Conservator of Forests, in *Punjab Government Gazette* Notification No. 218, dated 11th May, 1889, has been commuted by Her Majesty's Secretary of State for India to leave on medical certificate for 18 months.

No. 182.—*Mr. A. V. Monro*, Assistant Conservator of Forests, 2nd grade, passed with credit the Departmental Examinations in Land Revenue and Forest Law held at Lahore on the 28th and 29th of March, 1890.

No. 214.—*The 29th April, 1890.*—*Messrs. R. J. P. Pinder*, Assistant Conservator of Forests, and *E. A. Down*, Deputy Conservator of Forests, respectively made over and assumed charge of the Umballa Forest Division on the forenoon of 15th April, 1890.

No. 223.—*The 6th May, 1890*—Consequent on the return from privilege leave of *Mr. E. A. Down*, Deputy Conservator of Forests *Mr. R. J. P. Pinder*, Officiating Deputy Conservator, 4th grade, reverted to Assistant Conservator, 1st grade, sub. *pro tem.*, with effect from the forenoon of the 15th April, 1890.

8.—CENTRAL PROVINCES GAZETTE—

No. 1245.—*Mr. F. B. Dickinson*, Deputy Conservator of Forests, 2nd grade, is appointed to the charge of the Working Plans

Division, and placed under the orders of the Conservator of Forests, Northern Circle, with effect from the forenoon of the 7th December, 1889, the date on which he was relieved by *Colonel G. J. vanSomeren* of his duties of Conservator, Northern Circle.

No. 1844.—*The 1st April, 1890.*—With reference to Notification No. 497, dated the 29th January last, *Mr. J. C. Mendes*, Sub-Assistant Conservator of Forests, made over charge of his duties on the afternoon of the 4th March, 1890.

No. 1990.—*The 8th April, 1890.*—*Mr. F. C. Hicks*, Assistant Conservator of Forests, Mandla, availed himself, on the afternoon of the 15th March, 1890, of the two months' privilege leave granted to him by Notification No. 1187, dated the 3rd idem.

No. 2150.—*The 14th April, 1890.*—*Captain C. W. Losack*, Deputy Conservator of Forests, 1st grade, having returned from furlough, is posted to the Jubbulpore Forest Division.

Mr. A. Stewart, Deputy Conservator of Forests, on being relieved by *Captain C. W. Losack*, is transferred to the Damoh Forest Division.

Mr. A. Stewart and *Captain C. W. Losack*, respectively made over and received charge of the Jubbulpore Forest Division on the forenoon of the 1st April, 1890.

No. 2212.—*The 17th April, 1890.*—Leave on medical certificate, under Article 369 of the Civil Service Regulations, was granted to *Mr. J. C. Mendes*, Sub-Assistant Conservator of Forests, from the 28th November to the 29th December, 1889, both days inclusive.

No. 2382.—*The 24th April, 1890.*—In consequence of the return from furlough of *Captain C. W. Losack*, Deputy Conservator of Forests, 1st grade, the following reversions will take place from the 1st April, 1890 :—

Mr. W. P. Thomas, Officiating Deputy Conservator, 2nd grade, to Deputy Conservator, 3rd grade.

Mr. H. Moore, Officiating Deputy Conservator, 3rd grade, to Deputy Conservator, 4th grade, sub. *pro tem.*

Mr. A. E. Lowrie, Officiating Deputy Conservator, 4th grade, to Assistant Conservator, 1st grade, sub. *pro tem.*

9.—Burma Gazette—

No. 31.—*The 25th February, 1890.*—With the previous sanction of the Government of India *Maung Shwe Ka*, Forest Ranger, 5th grade, in the Tenasserim Forest Circle, is appointed to be a Sub-Assistant Conservator of Forests on probation, with effect from the 1st February, 1890, to fill the vacancy caused by the resignation of *Mr. W. G. F. Haslett.*

No. 32.—*Mr. C. W. Allan*, Sub-Assistant Conservator of Forests, is transferred from Shwegyin to the Upper Burma Circle.

No. 33.— *Mr. H. N. Thompson*, Assistant Conservator of Forests, is transferred from Pyinmana to the Chindwin Forest Division.

No. 6.—*The 27th February, 1890.*—*Mr. C. W. Allan*, Sub-Assistant Conservator of Forests, joined the Shwegyin Division on the afternoon of the 7th February, 1890.

No. 2.—*The 12th March, 1890.*—With reference to Revenue Department Notification No. 33 (Forests), dated the 25th February, 1890, *Mr. H. N. Thompson* assumed charge of his duties in the Chindwin Division on the forenoon of the 10th March, 1890.

No. 45.—*The 13th March, 1890.*—Under the provisions of Section 70 of the Burma Forest Act, 1881, the Chief Commissioner, as a special case, invests *Mr. R. M. G. Martin*, Head Clerk and Accountant of the Kado Divisional Office, with the following powers, that is to say:—

(i). The powers of a Civil Court to compel the attendance of witnesses and the production of documents.

(ii). Power to issue search warrants under the Code of Criminal Procedure.

(iii). Power to hold enquiries into forest offences and, in the course of such enquiries, to receive and record evidence.

No. 47.—*The 19th March, 1890.*—The following alterations of rank are ordered:—

(1). With effect from the 4th November, 1889, consequent on the return of *Mr. J. Copeland* from privilege leave—

Mr. H. A. Hoghton, Deputy Conservator of Forests, 4th (officiating 3rd) grade, to revert to his substantive rank.

(2). With effect from the 25th November, 1889, consequent on the return of *Mr. T. H. Aplin* from furlough—

Mr. H. Slade, Deputy Conservator, 3rd (officiating 2nd) grade, to revert to his substantive rank.

Mr. J. Copeland, Deputy Conservator, 4th (officiating 3rd) grade, to revert to his substantive rank.

No. 48.—Under the provisions of Article 291 of the Civil Service Regulations privilege leave for three months is granted to *Mr. G. Q. Corbett*, Officiating Deputy Conservator of Forests, with effect from the date on which he may avail himself of it.

10.—Mysore Gazette—

No. 354.—*The 1st March, 1890.*—The following will be substituted for Notification No. 287, dated 9th January, 1890:—

Mr. C. E. M. Russell, Superintendent of Forests, Bangalore, availed himself of the leave on medical certificate granted him in Notification No. 273, dated 23rd December, 1889, from the 11th idem.

Mr. S. A. Bapu Rao assumed charge of the Office of Superintendent of Forests, Bangalore, on the forenoon of the 14th December, 1889.

No. 365.—*The 6th March, 1890.*—*Mr. M. Venkatanaranappa*, Sub-Assistant Conservator, Shimoga District, is granted privilege leave for two months from such date as he may avail himself of the same.

No. 1047.—*The 20th March, 1890.*—*Mr. C. Narayana Rao*, Assistant Conservator of Forests, Mysore District, is granted privilege leave of absence for two months with effect from such date as he may avail himself of the same.

Mr. B. Ramaswami Iyer, Sub-Assistant Conservator of Forests, is appointed to act as Assistant Conservator of Forests, Mysore, during the absence of *Mr. Narayana Rao*, or until further orders.

No. 182-31.—*The 10th April, 1890.*—*Mr. C. Narayana Rao*, Assistant Conservator, delivered over, and *Mr. B. Ramaswami Iyer*, Sub-Assistant Conservator, assumed, charge of the District Forest Office, Mysore, on the afternoon of the 6th instant.

No. 1.—*The 23rd April, 1890.*—*Mr. B. Srinivasa Rao*, Sub-Assistant Conservator of Forests, Tumkur District, not having availed himself of the 10 days' privilege leave granted to him by Notification No. 320 of the 4th February last, the same is hereby cancelled.

Gradation List of Conservators, Deputy, Assistant, and Sub-Assistant Conservators, and of Forest Rangers in the Bombay Presidency, as it stood on the 2nd April, 1890.

NOTE.—(1).—The figure (1) shown in column 4 denotes that the officer has passed the prescribed Departmental Examination in Land Revenue systems and Forest law.
(2).—Officers appointed by the Secretary of State are indicated by an asterisk before their names.
(3).—M. means Marathi, G. Gujrati, H. Hindustani, K. Kanarese, Sin. Sindhi, Ur. Urdu, Bel. Beluchi.

Number.	Names.	Date of birth.	Languages in which passed.	Station.	Date of Substantive Gazetted Appointment.		Remarks.
					To Forest Department.	To present grade.	
	CONSERVATORS.						
	1st Grade (1), *Rs.* 1,500.						
1	A. T. Shuttleworth, late I. N.,	21st October, 1839,	M. (H. S.)	Northern Circle,	19th November, 1863,	22nd December, 1883.	...
	2nd Grade (1), *Rs.* 1,250.						
1	Colonel J. G. McRae, Bo. S. C.,	15th March, 1841,	H.M.G.Ur.,	Sind Circle, ...	17th November, 1871,	28th December, 1886.	...
	3rd Grade (1), *Rs.* 1,000.						
1	*J. L. Laird MacGregor,	9th February, 1848,	...	Southern Circle,	16th January, 1872,	Do. ...	...

	DEPUTY CONSERVATORS.						
	1st Grade (2), *Rs.* 900.						
1	*W. Hexton*, ...	31st March, 1847,	Sin. (L. S.) (1),	Surat—Northern Circle,	30th May, 1869,	21st April, 1887,	On privilege leave for 2 months and 19 days, from 31st January, 1890.
2	*F. R. Desái, ...	20th July, 1846,	Sin. (L. S.) (1),	East Khándesh—Northern Circle,	9th December, 1869,	6th December, 1887.	...
	2nd Grade (3), *Rs.* 800.						
1	*R. C. Wroughton, ...	15th August, 1849,	M. (1),	Poona—Northern Circle,	10th December, 1871,	21st April, 1887,	Acting 1st Grade Deputy Conservator from 31st January, 1890.
2	*G. A. Hight, ...	7th February, 1851,	Sin. (1),	Dhárwár—Southern Circle,	5th December, 1872,	14th July, 1887.	...
3	W. G. Betham, ...	26th March, 1853,	M.[c] (H. S.) K. (H. S.) (1).	Násik—Northern Circle,	15th July, 1873,	6th December, 1887.	...
	3rd Grade (4), *Rs.* 650.						
1	*H. Mainwaring, ...	28th September, 1848,	M. (1),	...	6th December, 1873,	28th December, 1886,	On furlough for one year, from 5th November, 1889.
2	*T. B. Fry, ...	8th July, 1850,	G. (1),	Working Plans Divisional Forest Officer, Northern Circle,	Do., ...	21st April, 1887,	Acting 2nd grade Deputy Conservator from 31st January, 1890.

Number.	Names.	Date of birth.	Languages in which passed.	Station.	Date of Substantive Gazetted Appointment.		Remarks.
					To Forest Department.	To present grade.	
	DEPUTY CONSERVATORS—(*continued*).						
	3rd Grade (4), *Rs.* 650—(continued).						
3	G. K. Betham, ...	15th October, 1850,	M. (H. S.) K. (H. S.) (1),	Kolába—Southern Circle,	1st August, 1878,	14th July, 1887.	...
4	*C. Greatheed, ...	8th August, 1845,	Sin. (H. S.) (1),	Sátára—Northern Circle,	6th December, 1872,	6th December, 1887.	...
	4th Grade (7), *Rs.* 550.						
1	*W. A. Talbot, ...	19th December, 1854,	M. (L. S.) K. (L. S.) (1),	North Kánara—Southern Circle,	28th December, 1876,	5th November, 1885,	Acting 3rd grade Deputy Conservator from 30th September, 1889.
2	*R. S. Fagan, ...	25th October, 1853,	M. (1),	West Khándesh—Northern Circle,	26th November, 1877,	23rd December, 1885,	Acting 3rd grade Deputy Conservator from 31st January, 1890.

3	*W. R. Woodrow, ...	29th May, 1855,	K.(H.S.) (1),	South Kánara—Southern Circle,	5th December, 1878,	Do. ...	...
4	A. Stewart, ...	27th June, 1852,	M.,	...	26th September, 1872,	28th December, 1886,	Serving in the Central Provinces from 9th October, 1889.
5	A. D. Wilkins, ...	22nd July, 1856,	M. (H. S.) (1),	Ahmednagar—Northern Circle,	13th March, 1878,	21st April, 1887.	...
6	*F. Gleadow,... ...	12th March, 1856,	Sin. (H. S.) G. (Ord.) (1),	North Thána—Northern Circle,	4th December, 1879,	14th July, 1887.	...
7	*H. Murray, ...	27th April, 1861,	K. (H. S.) (1),	Belgaum—Southern Circle,	30th November, 1882,	6th December, 1887.	...
	ASSISTANT CONSERVATORS.						
	1st Grade (5), *Rs.* 450.						
1	*H. W. Keys, ...	2nd November, 1861,	M. (H. S.) G. (L. S.) (1),	Panch Maháls—Northern Circle,	18th December, 1883,	12th January, 1886,	Acting 4th grade Deputy Conservator from 30th September, 1889.
2	S. Hornidge, A.M.I.C.E.,	15th December, 1846,	M. (H. S.) (1).	Sholápur—Northern Circle,	12th September, 1879,	28th December, 1886,	Acting 4th grade Deputy Conservator from 2nd November, 1889.
3	*G. P. Millett, ...	23rd March, 1863,	M. (H. S.) (1),	South Thána—Northern Circle,	24th November, 1884,	21st April, 1887,	Acting 4th grade Deputy Conservator from 31st January, 1890.

Number.	Names.	Date of birth.	Languages in which passed.	Station.	Date of Substantive Gazetted Appointment.		Remarks.
					To Forest Department.	To present grade.	
	Assistant Conservators — (*continued*).						
	***1st Grade* (5), *Rs.* 450— (continued).**						
4	*T. R. D. Bell, ...	2nd May, 1863,	K. (H. S.) (1),	Central Kánara—Southern Circle,	24th November, 1884,	14th July, 1887.	...
5	G. M. Ryan, ...	22nd September, 1859,	M. (H. S.) Sin. (L.S.) Bel. (1).	Sukkur—Sind Circle,	22nd December, 1883,	11th November, 1888.	...
	***2nd and 3rd Grades* (5).**						
	***2nd Grade, Rs.* 350.**						
1	R. P. Ryan, ...	28th August, 1859,	G. (H. S.) M. (H. S.) (1),	Bijápur—Southern Circle,	Do. ...	31st October, 1888,	Acting 1st grade Assistant Conservator from 6th September, 1887.
	***3rd Grade, Rs.* 250.**						
2	*E. G. Oliver, ...	...	K.	Kánara—Southern Circle,	26th December, 1887,	26th December, 1887.	...

3	*Vacant* (from 14th July, 1887),	...	...	...	...	...	...
4	*Vacant* (from 6th December, 1887),	...	...	...	...	...	...
5	*Vacant* (from 11th November, 1888),	...	...	...	...	...	...
	SUB-ASSISTANT CONSERVATORS.						
	1st Grade (3), *Rs.* 200.						
1	B. J. Haselden, ...	30th June, 1848,	...	Central Kánara—Southern Circle,	26th February, 1877,	10th June, 1882,	Acting 3rd grade Assistant Conservator from 26th September, 1885.
2	Lakshman Daji Joshi,	6th April, 1839,	...	Sátára—Northern Circle,	27th February, 1878,	21st October, 1888.	...
3	Neribdas valad Jethmal,	15th November, 1830,	...	Jerruck—Sind Circle,	9th November, 1882,	7th January, 1889.	...
	2nd Grade (4), *Rs.* 175.						
1	Showkirám Pribdás, ...	1st August, 1848,	(1),	Hyderabad—Sind Circle,	15th April, 1884,	20th June, 1887.	...
2	Váman Rámchandra Gaundi,	19th September, 1846,	...	Poona—Northern Circle,	17th June, 1884,	21st October, 1888.	...
3	J. M. Fernandez, ...	27th June, 1841,	...	...	13th August, 1884,	7th January, 1889,	Serving in the Kolhápur State from 9th June, 1887.

Number.	Names.	Date of birth.	Languages in which passed.	Station.	Date of Substantive Gazetted Appointment.		Remarks.
					To Forest Department.	To present grade.	
	Sub-Assistant Conservators—(*continued*).						
	***2nd Grade* (4), *Rs.* 175—(continued).**						
4	Rustamji H. Mádan, L.C.E.,	7th July, 1862,	M. (H. S.) (1),	Surat—Northern Circle,	7th June, 1886,	2nd November, 1888,	Acting 3rd Grade Assistant Conservator from 8th March, 1886.
	***3rd Grade* (6), *Rs.* 150.**						
1	W. G. Clabby, ...	25th December, 1863,	M. (H. S.) (1),	...	7th May, 1887,	7th May, 1887,	Serving in Rájpipla State from 11th October, 1888.
2	W. A. Wallinger, ...	11th November, 1868,	M. (Ord.)	Násik—Northern Circle,	20th June, 1887,	20th June, 1887.	...
3	Haripad Mitra, L.C.E.,	6th January, 1860,	M. (H. S.) (1),	Kánara—Southern Circle,	14th July, 1887,	14th July, 1887.	...
4	A. R. Maidment, ...	...	...	...	6th November, 1887,	6th November, 1887,	Sub. *pro tem.* Police Probationer doing duty at Thána.
5	Shesho Manju, ...	...	...	Kánara—Southern Circle,	2nd November, 1888,	2nd January, 1889.	...

6	Tuljárám Nihálchand, ...	...	...	Naushahro—Sind Circle,	7th January, 1889,	7th January, 1889.	...
	FOREST RANGERS.						
	NORTHERN CIRCLE.						
	1st Grade (3), *Rs.* 100.						
1	Shekh Abás Shekh Ali Potrik,	19th January, 1834,	...	North Thána (Máhim),	12th November, 1863,	23rd November, 1887.	...
2	Hasanali Muhammad Ali,	20th September, 1850,	...	North Thána (Dáhánu),	11th November, 1874,	1st June, 1887.	...
3	Joseph Baptista, L.C.E.,	17th March, 1865,	...	...	2nd September, 1887,	2nd September, 1887,	Acting Sub-Assistant Conservator, 3rd grade, from 21st May, 1889.
	2nd Grade (4), *Rs.* 80.						
1	Iláibaksh Khájbaksh, ...	6th June, 1845,	...	East Khándesh (Edalabad),	1st January, 1871,	1st April, 1882,	On sick leave from 22nd October, 1889.
2	Chimnáji Parashrám Vaidya,	17th June, 1836,	...	Ahmednagar (Sangamner),	25th November, 1863,	23rd November, 1883.	...
3	Valabhrám Mulji Bhat,	11th February, 1843,	...	Surat (Dangs),	16th December, 1871,	1st May, 1884.	...
4	Káshináth Mahipat Bhadé,	20th November, 1835,	...	Poona (Khed),	7th January, 1864,	1st May, 1885.	...
	3rd Grade (6), *Rs.* 60.						
1	Náráyan Sakhárám Khare,	2nd July, 1838,	...	Sholápur,	12th June, 1878,	1st June, 1887,	On furlough for 6 months from 8th December, 1889.

Number.	Names.	Date of birth.	Languages in which passed.	Station.	Date of Substantive Gazetted Appointment.		Remarks.
					To Forest Department.	To present grade.	
	FOREST RANGERS—(*continued*).						
	NORTHERN CIRCLE—(*continued*).						
	2nd Grade (4), *Rs.* 80—(continued).						
2	Bholánáth Ranchordás,	9th May, 1845,	...	Surat (Bulsár),	7th April, 1866,	23rd November, 1878.	...
3	Lakshman Bhivaji Pápdé,	22nd May, 1843,	...	Násik (Dindori),	23rd August, 1860,	1st May, 1885.	...
4	Váman Gopál Tumne,	5th June, 1860,	...	...	15th November, 1882,	Do., ...	On deputation to Rájkot State.
5	Abdul Rasul Khájbaksh,	5th June, 1853,	...	East Khándesh (Chopda),	16th December, 1876,	1st May, 1885.	...
6	Vishnu Máhádoo Tilak,	10th May, 1859,	...	Poona (Haveli),	1st January, 1882,	6th November, 1889.	...
	4th Grade (12), *Rs.* 50.						
1	Dámodhar Moreshvar Deuskar,	6th October, 1842,	...	Panch Maháls (Godhra),	13th July, 1872,	1st June, 1887,	Acting 3rd Grade from 4th December, 1888.

2	Aminuddin Aliuddin, ...	21st March, 1844,	...	East Khándesh (Bhusáwal),	12th June, 1869,	24th June, 1878.	...
3	Báláji Náráyan Kogjé,	6th March, 1838,	...	Poona (Sirúr),	1st March, 1856,	1st April, 1882.	...
4	Govind Rámchándra Tákle,	16th September, 1857,	...	South Thána (Sháhápur),	1st January, 1882,	16th October, 1884.	...
5	Báláji Dhondeo Dhekne,	25th April, 1848,	...	Poona (Junnar),	10th December, 1874,	1st May, 1885.	...
6	Kásim Aga Mirza Aga,	14th September, 1850,	...	Násik (Peint),	19th January, 1870,	Do. ...	...
7	Harilál Chandraprasad Desái,	7th February, 1860,	...	South Thána (Bhiwndi),	7th January, 1881,	1st May, 1885.	...
8	Rámchandra Rávji Bodvadkar,	26th January, 1854,	...	Násik (Málegaon),	7th December, 1872,	1st April, 1886.	...
9	Vásudeo Rámchandra Gháisas,	30th September, 1842,	...	Ahmednagar (Nagar),	15th October, 1863,	29th April, 1886.	...
10	Sitárám Hari Vaze, ...	17th May, 1858,	...	Násik (Igatpuri),	5th January, 1882,	1st October, 1886.	...
11	Keshav Pandurang Kovethekar,	25th March, 1850,	...	Sátára (Pátan),	20th October, 1873,	20th January, 1889.	...
12	*Vacant.*	...	...	...	...	...	...
	SOUTHERN CIRCLE.						
	1st Grade (2), *Rs.* 100.						
1	*R. G. C. Westbrook,* ...	20th October, 1842,	...	In charge Coast Timber Depôt, Kárwár, N. D., Kánara,	11th July, 1874,	11th July, 1874.	...

Number.	Names.	Date of birth.	Languages in which passed.	Station.	Date of Substantive Gazetted Appointment.		Remarks.
					To Forest Department.	To present grade.	
	Southern Circle—(*continued*).						
	1*st Grade* (2), *Rs.* 100—(continued).						
2	Bálkrishna Dámodhar,	21st March, 1834,	...	Belgaum (Chikodi Range),	10th August, 1860,	12th February, 1880.	...
	2*nd Grade* (4), *Rs.* 80.						
1	Yeshvant Báburáo, ...	5th August, 1841,	...	C. D., Kánara (Yellápur),	1st February, 1866,	13th October, 1885.	...
2	C. S. Menezes, ...	1st March, 1832,	...	N. D. (Kánara Kodibág Timber Depôt, Kárwár,)	5th October, 1875,	13th October, 1885.	...
3	Durgápa Subrámani, ...	2nd January, 1842,	...	C. D., Kánara,	1st April, 1876,	Do., ...	Fitter in the Kánara Saw Mills, Kannigeri.
4	B. G. Deshpánde, ...	29th March, 1859,	...	Northern Division—Kánara, Kárwár,	1st January, 1881,	Do. ...	...

	3rd Gr (2), *Rs.* 60.						
1	Gan[illegible]ayavant Rege,	9th September, 1855,	...	Belgaum, Khánápur,	18th November, 1879,	25th October, 1887.	...
2	C[illegible]Wartak, ...	1856, ...	...	Ratnágiri,	30th January, 1878,	21st January, 1890.	...
	[illegible]h Grade (3), *Rs.* 50.						
1	Ganpat Rámji Mane, ...	28th February, 1857,	...	Belgaum (Khánápur Range),	1st February, 1876,	13th October, 1885,	On sick leave for 1 month from 26th February, 1890.
2	Mangeshráo Nágapa, ..	8th June, 1846,	...	S. D., Kánara (Sirsi Range),	4th August, 1883,	Do. ...	...
3	Ghosekhán valad Abdul Muhammadkhán,	27th November, 1852,	...	N. D. Kánara (Haliyál Range),	27th November, 1882,	Do., ...	*Pro tem.* 2nd Grade from 1st October, 1887.
	FOREST RANGERS.						
	SIND CIRCLE.						
	2nd Grade (1), *Rs.* 80.						
1	Peribdás, ...	14th November, 1823,	...	Hyderabad (Miani),	7th October, 1856,	1st April, 1885,	...
	3rd Grade (1), *Rs.* 70.						
1	Rámbux, ...	4th January, 1837,	...	Hyderabad, (Rano),	30th November, 1867,	16th August, 1889.	...

Number.	Name.	Date of birth.	Languages in which passed.	Station.	Date of Substantive Appointment.		Remarks.
					To Forest Department.	To present grade.	
	FOREST RANGERS—(*continued*).						
	SIND CIRCLE—(*continued*).						
	4th Grade (1), *Rs.* 60.						
1	Gobindbux, ...	4th September, 1835,	...	Hyderabad (Unarpur),	14th August, 1860,	16th August, 1889.	...
	5th Grade (2), *Rs.* 50.						
1	Permánand, ...	23rd June, 1844,	...	Sháhbandar,	1st September, 1869,	1st April, 1885.	...
	Metharám, ...	5th January, 1867,	...	Ahad,	26th February, 1888,	16th August, 1889.	...